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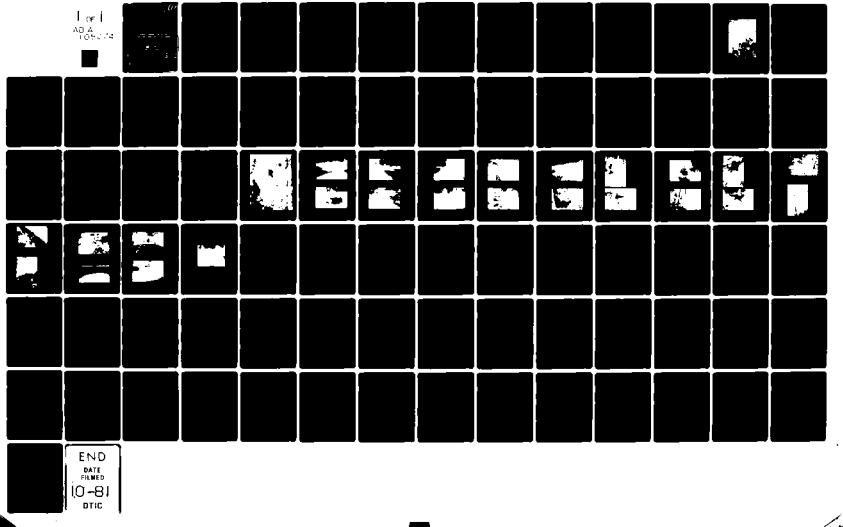

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MISSOURI - KANSAS CITY BASIN

AD A105274

JUNIOR LAKE DAM

CALLAWAY COUNTY, MO.

MO 11526

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

OCTOBER, 1980

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A105 274	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Dam Inspection Report National Dam Safety Program Junior Lake Dam (MO 11526) Callaway County, Missouri		5. TYPE OF REPORT & PERIOD COVERED Final Report 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Hoskins-Western-Sonderegger, Inc.		8. CONTRACT OR GRANT NUMBER(s) DACW43-80-C-0071
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101		12. REPORT DATE October 1980 13. NUMBER OF PAGES Approximately 70
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

National Dam Safety Program. Junior Lake Dam, (MO 11526) Missouri - Kansas City Basin, Callaway County, MO. Phase I Inspection Report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dam Safety, Lake, Dam Inspection, Private Dams

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

JUNIOR LAKE DAM

CALLAWAY COUNTY, MISSOURI

MISSOURI INVENTORY NO. MO 11526

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

PREPARED BY
HOSKINS-WESTERN-SONDEREGGER, INC.
CONSULTING ENGINEERS
LINCOLN, NEBRASKA

UNDER DIRECTION OF

ST. LOUIS DISTRICT, CORPS OF ENGINEERS

FOR

GOVERNOR OF MISSOURI

OCTOBER, 1980

DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 TUCKER BOULEVARD, NORTH
ST. LOUIS, MISSOURI 63101

REPLY TO ATTENTION OF

LMSED-PD

SUBJECT: Junior Lake Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Junior Lake Dam MO 11526.

It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, emergency by the St. Louis District as a result of the application of the following criteria:

a. Spillway will not pass a 10-year frequency flood without overtopping of the dam. The spillway is, therefore, considered to be unusually small and seriously inadequate.

b. Overtopping could result in dam failure.

c. Dam failure significantly increases the hazard to life and property downsteam.

SIGNED

Submitted By: _____ 11 MAR 1981
Chief, Engineering Division — Date

SIGNED

Approved By: _____ 11 MAR
Colonel, CE, District Engineer — Date

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM
ASSESSMENT SUMMARY

Name of Dam	Junior Lake Dam
State Located	Missouri
County Located	Callaway County
Stream	Smith Branch
Date of Inspection	October 6, 1980

Junior Lake Dam was inspected by an interdisciplinary team of engineers from Hoskins-Western-Sonderegger, Inc. The purpose of the inspection was to make an assessment of the general conditions of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers and developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers.

Junior Lake Dam has a height of thirteen (13) feet and a storage capacity at the minimum top elevation of the dam of seventy-two (72) acre-feet. In accordance with the guidelines, a small size dam has a height greater than or equal to twenty-five (25) feet but less than forty (40) feet and a storage capacity greater than or equal to fifty (50) acre-feet but less than one thousand (1,000) acre-feet. The size classification is determined by either the storage capacity or height, whichever gives the larger size category. Junior Lake Dam is classified as a small size dam.

In accordance with the guidelines and based on visual observation, the dam is classified as having a high hazard potential. Failure would threaten life and property. The estimated damage zone extends approximately two (2) miles downstream of the dam. Within the damage zone are a railroad embankment at 0.1 mile, a dwelling at 0.2 miles, two large commercial buildings at 0.25 miles, two dwellings at 0.3 miles, thirteen dwellings at 0.4 to 0.6 miles, a park at 0.8 miles and a building at 1.0 mile.

Our inspection and evaluation indicates that the spillway does not meet the criteria set forth in the recommended guidelines for a small dam having a high hazard potential. Considering the height of the dam, and the small volume of water impounded, 50% of the Probable Maximum Flood is the appropriate spillway design flood. The spillway will not pass the Probable Maximum Flood or the 10-year flood (10% probability flood, a flood having a 10% chance of being exceeded in any year) without overtopping the dam. The spillway will pass 10% of the Probable Maximum Flood (PMF) without overtopping the dam. The Probable Maximum Flood is defined as the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

Junior Lake Dam is in very poor condition and has a serious potential of failure due to severe erosional damage of the upstream face and the crest; rodent burrows; dense tree and brush growth on the crest and downstream slope; and a severely inadequate spillway. There apparently has been little maintenance work done on this dam.

Design data were not available for this dam. Based on the observations made during the field inspection of the dam, the following remedial measures should be performed under the guidance of a professional engineer experienced in the design and construction of dams:

a. Alternatives.

(1) Studies should be performed to determine the amount of siltation in the reservoir, the stage-storage relationships of the reservoir, and the extent of downstream damages that could result from failure of the dam. The results of these studies should be used in implementation of the remedial measure recommended in the following paragraph.

(2) The height of the dam should be increased in order to pass 50 percent of the probable maximum flood through the existing spillway without overtopping the dam.

b. Operation and Maintenance Procedures.

(1) Seepage and stability analyses comparable to the requirements of the recommended guidelines should be performed by an engineer experienced in the design and construction of dams.

(2) Trees and brush should be removed from the embankment and the spillway exit section. Tree removal should be done under the guidance of an engineer experienced in the design and construction of dams.

(3) Rodent burrows in the embankment should be eliminated.

(4) Cracks and spalls in the concrete spillway should be repaired.

(5) The water level should be lowered and/or the reservoir should be drained in order to facilitate the rehabilitation of the reservoir and the modification of the dam.

(6) A program of periodic inspection and regular maintenance should be instituted. Maintenance procedures should be focused on eliminating tree growth and rodent activity as well as making timely repairs of eroded areas and the spillway system. All records of inspections and maintenance operations should be made a part of this project file.

Rey S. Decker
E-3703

Gordon Jamison

Harold Ulmer
Garold Ulmer
E-19246

H. P. Hoskins
Harold P. Hoskins, Chairman of the Board
Hoskins-Western-Sondereyger, Inc.
E-8696

PHOTO NO. 1 - OVERVIEW

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
JUNIOR LAKE DAM - MO 11526
CALLAWAY COUNTY, MISSOURI

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection of Junior Lake Dam be made.

b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams", Appendix D to "Report of the Chief of Engineers on the National Program of Inspection of Dams", dated May, 1975, and published by the Department of the Army, Office of the Chief of Engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances.

(1) Embankment. The dam is an earthfill structure approximately 13 feet in height and 717 feet in length constructed in an "L" shape with about 227 feet extending across the old channel on the south end and about 490 feet extending parallel to the railroad along the east side.

(2) Spillway. The spillway consists of a reinforced concrete weir and ogee chute and apron section located on the right end of the south leg of the dam. The weir section is 163 feet wide.

(3) Pertinent physical data are given in paragraph 1.3.

b. Location. The dam is located on the campus of William Woods College within the corporate limits of Fulton in the central part of Callaway County, Missouri, as shown on Plate A-2. The dam is shown on Plate A-1 in the SE 1/4 of Section 8, T47N, R9W.

c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines

referenced in paragraph 1.1c above. Junior Lake Dam has a height of 13 feet and a storage capacity of 72 acre-feet. This dam is classified as a small size dam. A small size dam has a height greater than or equal to 25 feet but less than 40 feet and a storage capacity greater than or equal to 50 acre-feet but less than 1,000 acre-feet. The size classification is determined by either the storage or height, whichever gives the larger size category.

d. Hazard Classification. Guidelines for determining hazard classification of dams and impoundments are presented in the guidelines as referenced in paragraph 1.1c above.

Aerial photographs of the downstream damage zone of this dam were taken in October, 1980. These photographs were used as reference in the field observations of the damage zone which were made during the inspection. Based on the field observations and on the referenced guidelines this dam is in the High Hazard Potential Classification. The estimated damage zone extends approximately two miles downstream of the dam. Within the damage zone are a railroad embankment at 0.1 mile, a dwelling at 0.2 miles, two large commercial buildings at 0.25 miles, two dwellings at 0.3 miles, thirteen dwellings at 0.4 to 0.6 miles, a park at 0.8 miles and a building at 1.0 mile.

e. Ownership. The dam is owned by William Woods College, c/o Mr. Larry Martin, Fulton, Missouri 69251.

f. Purpose of Dam. The dam impounds a lake which is used for recreation.

g. Design and Construction History. No design or construction data were available for this dam. Mr. Martin reported that the dam was originally constructed in the 1940's but washed out. The old earth dam was repaired in the early 1960's, and the concrete ogee-type spillway was constructed. The concrete weir crest was added to the spillway in either the late 1960's or early 1970's.

h. Normal Operating Procedure. There are no operating facilities for this dam. The pool level is controlled by rainfall, infiltration, evaporation, and the capacity of the uncontrolled spillway.

1.3 PERTINENT DATA

a. Drainage Area. 1852 acres (2.89 square miles).

b. Discharge at Damsite.

(1) All discharges at the damsite are through a reinforced concrete ogee-type spillway with a 2-foot wide concrete weir crest.

(2) Estimated maximum flood at damsite -- unknown.

(3) The spillway capacity varies from 0 c.f.s. at elevation 804.0 feet to 1216 c.f.s. at the minimum top of dam (elevation 805.6 feet).

(4) Total spillway capacity at the minimum top of dam is 1216 c.f.s. ±.

c. Elevations (feet above M.S.L.).

(1) Observed pool - 801.5 ±.

(2) Normal pool - 804.0 ±.

(3) Spillway crest - 804.0 ±.

(4) Maximum experienced pool - 805.5 ±.

(5) Top of dam (minimum) - 805.6 ±.

(6) Streambed - 793 ±.

(7) Maximum Tailwater - unknown.

d. Reservoir. Length (feet) of pool.

(1) At spillway crest - 1500 ±.

(2) At top of dam (minimum) - 1600 ±.

e. Storage (Acre-feet).

(1) Observed pool - 15 ±.

(2) Normal pool - 42 ±.

(3) Spillway crest - 42 ±.

(4) Maximum experienced pool - 70 ± (based on Mr. Martin's statement that 15 to 18-inch depths of water flow over the spillway at least once a year).

(5) Top of dam (minimum) - 72 ±.

f. Reservoir Surface (Acres).

(1) Observed pool - 7.1 ±.

(2) Normal pool - 14.9 ±.

(3) Spillway crest - 14.9 ±.

(4) Maximum experienced pool - 22.5 ±.

(5) Top of dam (minimum) - 23 ±.

g. Dam.

(1) Type - Earthfill.

(2) Length - 717 ft ± (227' ± south leg; 540' ± east leg).

(3) Height - 13 ft ± (south leg).

(4) Top Width - Varies: 14 ft maximum to 2 ft minimum.

(5) Side Slopes.

(a) Downstream (maximum section of south leg) - 1V on 2.6H, 1V on 4.7H, 1V on 7.7H (see plate C-3). Downstream (east leg) - 1V on 2H.

(b) Upstream (maximum section of south leg) - 1V on 3.6H. Upstream (east leg) - eroded to near vertical.

(6) Zoning - none.

(7) Impervious core - none.

(8) Cutoff - unknown.

(9) Grout curtain - none.

(10) Wave Protection - Approximately 167 feet of south leg riprapped. No protection on east 60 feet of south leg or entire east leg.

(11) Drains - none.

h. Diversion Channel and Regulating Tunnel. None.

i. Spillway.

(1) Type - Reinforced concrete weir crest and an ogee-type reinforced concrete spillway section.

(2) Control Section - Concrete weir having a trapezoidal cross section with the upstream face inclined and downstream face vertical. Weir length = 163 feet; Weir width = 2 feet.

(3) Crest Elevation - 804.0.

(4) Upstream Channel - + 12.5% grade; heavy vegetative growth.

(5) Downstream Channel - Badly overgrown with trees and brush, bedrock exposed some 100 feet below spillway.

j. Regulating Outlets. None.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No design data were available for this dam.

2.2 CONSTRUCTION

No construction data were available. It was reported by Mr. Martin that the earth dam was originally constructed sometime in the 1940's. The original dam washed out. The original earth dam was repaired and a concrete ogee-type spillway was constructed in the early 1960's. The existing concrete weir section was added to the spillway in the late 1960's or very early 1970's.

2.3 OPERATION

No data were available on spillway operation. Mr. Martin reported that water 15 to 18 inches in depth will flow over the spillway at least once each year.

2.4 EVALUATION

a. Availability. No data were available.

b. Adequacy. The field surveys and visual observations presented herein are considered adequate to support the conclusions of this report. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

c. Validity. Not applicable.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of the Junior Lake Dam was made on October 6, 1980. Engineers from Hoskins-Western-Sonderegger, Inc., Lincoln, Nebraska, making the inspection were:

Rey S. Decker - Geotechnical
Garold G. Ulmer - Hydraulics and Hydrology
Gordon Jamison - Hydraulics and Hydrology

The owner was represented during the inspection by Mr. Larry Martin.

b. Dam.

(1) Geology and Soils (abutment and embankment). This dam is located in the loess-till plains of Northern Missouri. Upland soils consist of the Mexico-Putnam Association on the nearly level areas which are developed on thin loess overlying dense glacial till and the Lindley-Keswick-Hatton Association on the gently rolling slopes which have developed on thin loess of glacial till overlying bedrock.

Materials in the embankment consist of silty clay, clayey silts and sand (CL-ML-fine SM). The right abutment consists of loess overlying till. Sandstone and limestone bedrock of the Marmaton or Cherokee Group of the Pennsylvania System is exposed in the stream channel downstream from the spillway.

Groundwater movement in the bedrock is along joints and bedding planes. No evidence of solution cavities was detected. This area is not included in the locations where catastrophic collapse into sinkholes is known to occur.

The embankment is in Seismic Zone 1 indicating a minor probability of earthquakes. No quakes have been reported within a 50-mile radius of the site. The only significant structural feature within a 10-mile radius is the Auxvasse Creek Anticline.

(2) Upstream Slope. The upstream slope is well covered with trees and brush. The extreme right end of the south leg of the dam (adjacent to the spillway) is protected with riprap. This riprap section extends from about Station 6+00 to the spillway. The riprap has provided good protection for this section of the dam. The upstream slope of the left (east) leg of the dam is badly eroded and is nearly vertical in many sections. Upstream erosion has reduced the crest width to as narrow as 2 to 3 feet in some sections. Some of the erosion on the upstream slope and into the crest appears to be the result of rodent (probably muskrat) activity. Photos 2, 3, 4, 5, and 6 show the overall slope. Photos 12, 13, 14, 15, and 16 show erosion of the upstream slope and the crest.

(3) Crest. The crest is overgrown with trees and brush. The width of the crest of the south leg is about 14 feet except near Station 5+70 ± (Photo No. 12). Approximately 10 feet of the crest has eroded to a depth of approximately 3 feet at this location, leaving a remaining crest width of 3 to 4 feet. Tree roots are exposed in this eroded area. Photo No. 12 shows this eroded area. Crest widths of the left (east) leg vary from about 2 feet to 9 feet as shown on Plate C-1 and in Photos 13, 14, 15, and 16. In some sections of the east leg tree roots are exposed from the upstream face through the crest. Measurements indicate that the crest elevation varies from about 805.0 to 806.7 with the lowest points being located along the east leg. Some settlement has undoubtedly occurred, but the profile in general probably reflects the irregularity of the profile when construction was completed. The left (east leg) end of the dam ties into the adjacent railroad grade. Materials in sections of the east leg are very silty (ML) and/or quite sandy (fine SM). Photos 10, 11, and 14 show the crest.

(4) Downstream Slope. The downstream slopes of both legs are overgrown with brush and trees up to 24 inches in diameter. No sliding, cracking, abnormal deformation or erosion was noted on the downstream slope of either leg. No indications of seepage were evident on the downstream slopes or along the toe of the dam. Photos 7 and 8 show the downstream slopes.

(5) Miscellaneous. The nature of the material in most of the east leg of the dam indicates that any overtopping would probably result in breaching of the dam.

c. Appurtenant Structures.

(1) Spillway. The spillway consists of a reinforced concrete weir with ogee-type chute. The weir section has been added to the original ogee structure, and there is some spalling of the concrete along the construction joint (see Photo 19). The weir section is badly cracked and fractured about 40 feet from the left end (see Photo 20). The ogee outlet section is in fair condition. One crack about 2 inches wide was observed in the floor section about 40 feet from the right side of the structure (see Photo 21). A number of small trees and bushes are growing in the construction joints and cracks in the outlet section. Photo 17 shows the weir crest and ogee section with tree and brush growth. The spillway discharges onto rock and concrete rubble that has been placed in the old channel bottom.

(2) Low-Level Outlet. There is no low-level outlet facility for this dam.

d. Reservoir Area. No significant erosion was evident around the shoreline. Mr. Martin reported that the reservoir has silted in considerably and that the present depth of the lake in the center is not over 3 to 4 feet deep. The lake is shown in Photos 1 and 23.

e. Downstream Channel. The channel downstream from the spillway structure has a number of small trees growing along the end of the structure and in the channel. Sandstone and limestone bedrock is exposed in the channel bottom downstream from the structure. Seepage outcrops in the bedrock about 50 feet downstream from the structure. The seep was standing in small pools and there was no flow down the channel.

3.2 EVALUATION

The embankment is in very poor condition. Wave erosion has removed much of the upstream slope of the east leg and has reduced the crest width to 2 or 3 feet in some sections. Most of the embankment is covered with trees and brush, and tree roots extend from the upstream slope through sections of the crest. Rodent holes have contributed to erosion of the crest. Some of the low spots on the crest line of the east leg are only 1.6 feet ± above the spillway elevation. No evidence of any recent overtopping was observed. However, the depths of flow over the spillway, as reported by Mr. Martin, would indicate that the low points along the east leg of the dam have been very near to overtopping. The spillway is in fair condition. However, the major cracks and spalling should be repaired to minimize future deterioration. Trees in the spillway outlet section should be removed.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

There are no controlled outlet works for this dam. The pool level is controlled by rainfall, infiltration, evaporation, and the capacity of the uncontrolled spillways.

4.2 MAINTENANCE OF DAM

There doesn't appear to be any regular maintenance of this dam. Erosion on the upstream face of the east leg is uncontrolled and is severe in several places. The crest, downstream slope, and spillway channel are overgrown with brush and trees, some up to 24 inches in diameter. The concrete spillway has some bad cracks, open joints and spalls.

4.3 MAINTENANCE OF OPERATING FACILITIES

No operating facilities exist at this dam.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no warning system in effect for this dam.

4.5 EVALUATION

No operational procedures exist for this dam. The lack of routine maintenance and repair has contributed to the poor condition of the dam and, if continued, will undoubtedly result in breaching of the dam.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. No design data were found for this dam.

b. Experience Data. The drainage area, reservoir surface area, and elevation-storage data were developed from the USGS Fulton, Missouri and Kingdom City, Missouri 7-1/2 minute topographic quadrangle maps. The hydraulic computations for the spillway and dam overtopping discharge ratings were based on data collected in the field at the time of the field inspection. Hydrologic computations are included in this report as Appendix D.

c. Visual Observations.

(1) The crest of the east leg and a portion of the south leg of the dam is severely eroded with crest widths as narrow as 2 feet. Minor overtopping would probably lead to a breach of the dam.

(2) The concrete weir and spillway has some bad cracks. Photo 20 shows a crack through the weir section. Spalling of the concrete at this crack has exposed the reinforcing steel. Photo 21 shows a 2-inch wide crack in the ogee spillway section downstream from the weir. The small willow tree is growing in the crack. Photo 19 shows the open construction joint between the ogee spillway section and the weir.

(3) The dam, as well as the spillway exit channel, is overgrown with brush and trees as shown in the photographs.

(4) The abutment on the north end of the east leg of the dam is lower than the minimum top of the dam. Some flow may be released and flow south between the dam embankment (east leg) and the railroad embankment. This flow was not considered in the routing procedure. The ditch section located at the north end of the east leg of the embankment and between the east leg of the dam and the railroad embankment is approximately 25 feet wide and is almost level with the top of the dam. Due to the small section and dense heavy vegetation, no significant flow would be released along the east toe of the dam embankment.

(5) The water level in the reservoir was 2.5 feet below the spillway weir crest at the time of inspection. The runoff from the upstream drainage area, which is almost 100% cultivated, has evidently contributed considerable amounts of silt as well as nutrients to the reservoir. The shallow water, as well as the nutrient content, has resulted in the heavy growth of algae and duck weed which is evident in the photographs. Photo 1 - Overview shows the low level of the reservoir at the time of inspection. The photograph on Plate B-1 shows the heavy weed and algae growth along the shores as well as algae blooms in

the lake. The degree of siltation of the reservoir is not known, but siltation would result in lowering the acre-feet of water impounded below the normal pool or spillway elevation and would result in a lesser volume being released in case of breaching of the dam. The analysis presented in tabular form below is based on water level at normal pool or spillway elevation at the beginning of the storm and would not be affected by siltation in the reservoir.

d. Overtopping Potential. Based on approximate analyses, the spillway is too small to pass 50 percent of the probable maximum flood without overtopping the dam. The spillway will not pass the ten percent probability flood but will pass 10 percent of the probable maximum flood without overtopping. Overtopping is dangerous because the flow of water over the crest could erode the face of the dam and, if continued long enough, could breach the dam with sudden release of all of the impounded water into the downstream floodplain. Based on these data, the hydrologic capability of Junior Lake Dam should be considered as seriously inadequate for a high hazard potential structure.

The results of the routings through the dam are tabulated in regards to the following conditions:

Frequency	Inflow Discharge c.f.s.	Outflow Discharge c.f.s.	Maximum Pool Elevation	*Maximum Depth Over Dam Feet	Duration Over Top Hours
10%	2060	2030	806.1	0.5	2+
1%	3100	3100	806.6	1.0	3±
1/2 PMF	5900	5900	807.2	1.6	7±
PMF	11800	11800	808.2	2.6	12+
0.10 PMF	1180	1160	805.6	0	0

*Minimum top of dam elevation - 805.6.

According to the recommended guidelines from the Department of the Army, Office of the Chief of Engineers, this dam is classified as having a high hazard potential rating and a small size. Therefore, the 1/2 PMF to PMF is the test for the adequacy of the dam and its spillway.

The estimated damage zone is described in paragraph 1.2 d in this report.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observation. The downstream slopes of both legs of the dam appear to be structurally stable with no sliding, cracking, abnormal deformation or erosion. The westernmost portion of the upstream face of the south leg, which is protected with riprap, is in good condition with no signs of distress. The upstream slopes of the remainder of the south leg and most of the east leg, which were not protected with riprap, are badly eroded as stated in paragraph 3.2b(2) of this report. Rodent activity (probably muskrat) on the upstream face has allowed water penetration in several locations with subsequent collapse of the upstream slope and significant portions of the crest. The materials from which the dam is constructed are not erosion resistant and continued erosion in the areas where only 2 to 3 feet of crest remains could result in fairly rapid breaching of the dam with less water level in the reservoir than would be required for overtopping.

b. Design and Construction Data. No design or construction data were available. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

c. Operating Records. There are no controlled operating facilities for this dam.

d. Post-Construction Changes. The inspection team is not aware of any post-construction changes other than the addition of the concrete weir crest to the spillway in either the late 1960's or early 1970's.

e. Seismic Stability. This dam is located in Seismic Zone 1. An earthquake of the magnitude predicted in this area is not expected to cause structural failure of this dam.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. This dam is in very poor condition with a serious potential of failure. Failure could occur prior to the water in the reservoir overtopping the low point of the dam. The upstream slope and crest of the east leg and a portion of the south leg not protected by riprap has eroded to a depth lower than the spillway crest. Remaining crest width in several locations varies from 2 to 3 feet. Continued wave action with the water at the spillway crest elevation or above could erode through the crest in any of the several locations where most of the crest has been eroded away. The materials from which the dam is constructed offer little resistance to erosion. The lack of riprap on the upstream slope of the east leg and a portion of the south leg, rodent activity on the embankment and uncontrolled brush and tree growth have contributed heavily to the problems of this dam. Siltation has been and will continue to be a problem with the reservoir. Approximate analyses performed for this report indicate that the dam is seriously inadequate from the hydrologic standpoint. The ten percent probability flood will overtop the dam by 0.5 foot for about 2 hours. The extent of the damage that would result from overtopping and probable breaching of the dam is not known, but it should be less than normally expected due to decreased reservoir capacity caused by siltation.

Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

b. Adequacy of Information. No design or construction data were available. The conclusions in this report are based upon performance history and the visual inspection of the structure. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

c. Urgency. The items recommended in paragraphs 7.2.a. and 7.2.b. should be pursued on a high priority basis.

d. Necessity for Further Investigations. The additional studies and analyses recommended in paragraph 7.2b should be accomplished by the owner on a high priority basis.

e. Seismic Stability. This dam is located in Seismic Zone 1. An earthquake of this magnitude is not expected to be hazardous to this dam. It is recommended, however, that the prescribed seismic loading for Seismic Zone 1 be applied in any stability analyses performed for this dam.

7.2 REMEDIAL MEASURES

The following remedial measures and maintenance procedures are recommended. All remedial measures should be performed under the guidance of a registered professional engineer experienced in the design and construction of earth dams.

a. Alternatives.

(1) Studies should be performed to determine the amount of siltation in the reservoir, the stage-storage relationships of the reservoir, and the extent of downstream damages that could result from failure of the dam. The results of these studies should be used in implementation of the remedial measure recommended in paragraph 7.2.a.(2).

(2) The height of the dam should be increased in order to pass 50 percent of the probable maximum flood through the existing spillway without overtopping the dam.

b. Operation and Maintenance Procedures.

(1) Seepage and stability analyses comparable to the requirements of the recommended guidelines should be performed by an engineer experienced in the design and construction of dams.

(2) Trees and brush should be removed from the embankment and the spillway exit section. Tree removal should be done under the guidance of an engineer experienced in the design and construction of dams.

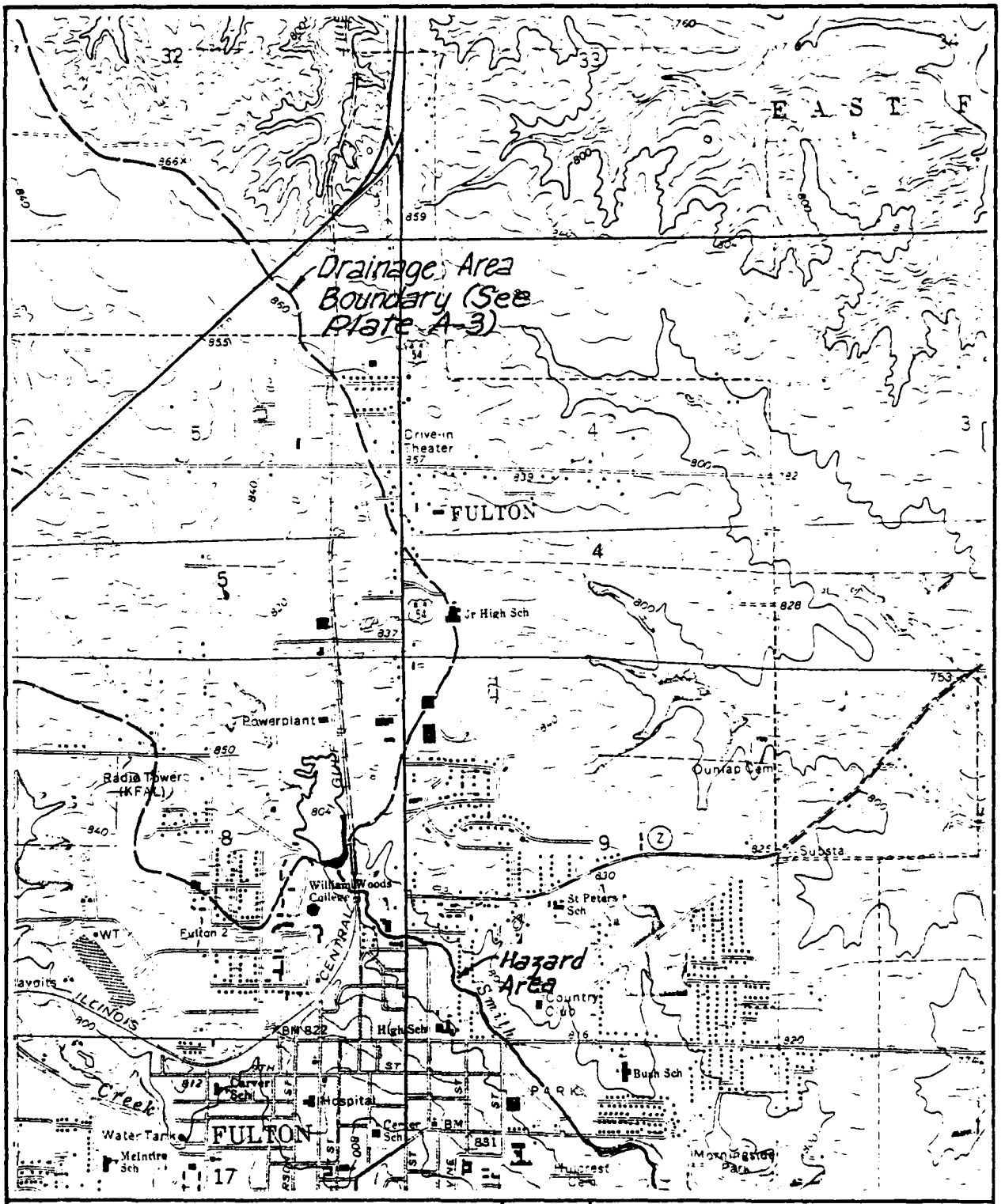
(3) Rodent burrows in the embankment should be eliminated.

(4) Cracks and spalls in the concrete spillway should be repaired.

(5) The water level should be lowered and/or the reservoir should be drained in order to facilitate the rehabilitation of the reservoir and the modification of the dam.

(6) A program of periodic inspection and regular maintenance should be instituted. Maintenance procedures should be focused on eliminating tree growth and rodent activity as well as making timely repairs of eroded areas and the spillway system. All records of inspections and maintenance operations should be made a part of this project file.

APPENDIX A
MAPS



Scale in feet

2000 1000 0 2000 4000

Contour Interval – 20'

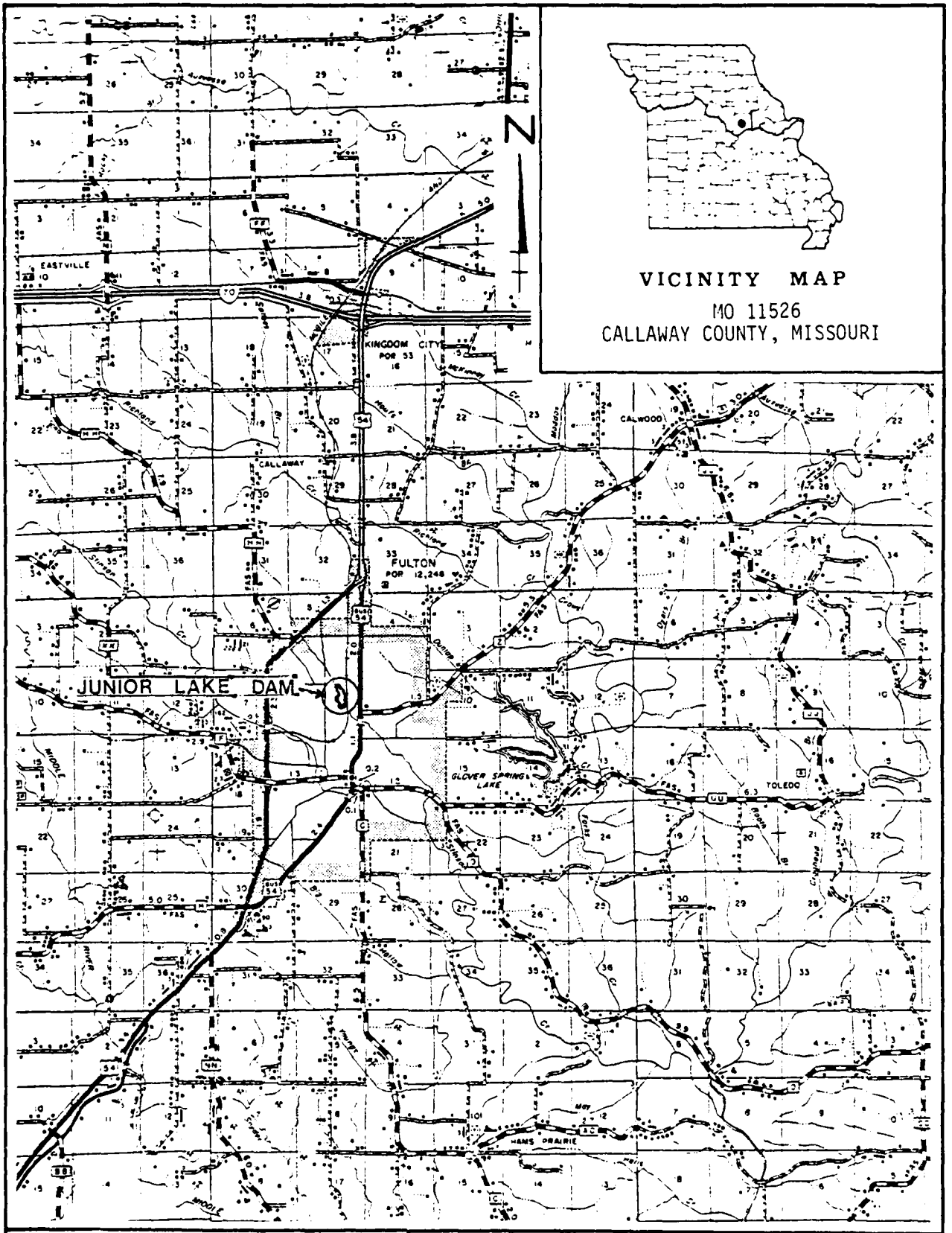
N

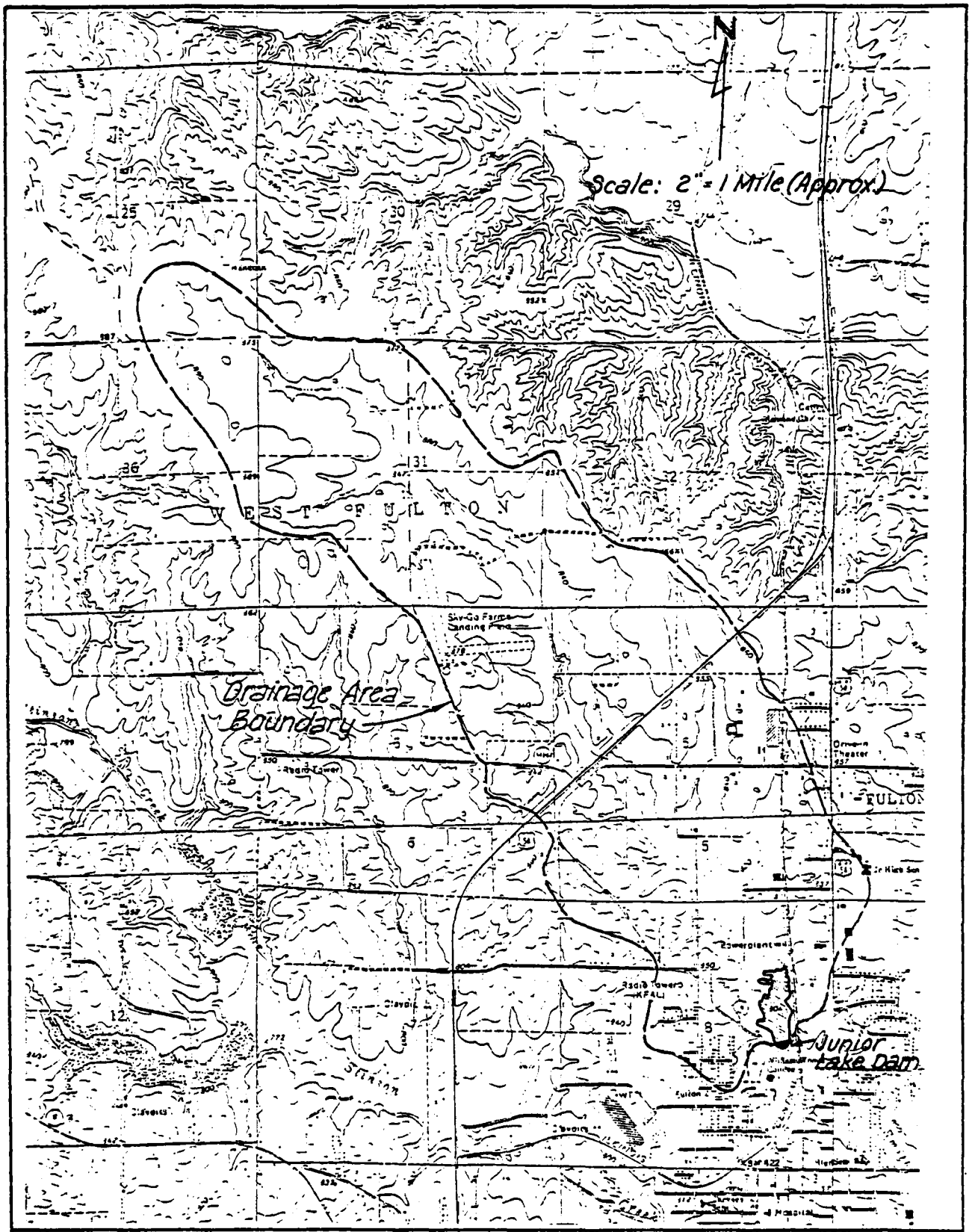
VICINITY TOPOGRAPHY

JUNIOR LAKE DAM

CALLAWAY COUNTY, MO.

MO 11526 PLATE A-1


N
EASTVILLE
KINGDOM CITY
POP 53
CALLAWAY
FULTON
POP 12,248
CALWOOD
JUNIOR LAKE DAM
GLOVER SPRING LAKE
TOLEDO
HAMS PRAIRIE
VICINITY MAP
MO 11526
CALLAWAY COUNTY, MISSOURI
Scale in miles
0 1 2 3 4 5
LOCATION MAP
PLATE A-2



JUNIOR LAKE DAM

CALLAWAY COUNTY, MO.

MO 11526

DRAINAGE AREA MAP

PLATE A-3

APPENDIX B
PHOTOGRAPHS

JUNIOR LAKE DAM
CALLAWAY COUNTY, MISSOURI
MO 11526

PHOTO INDEX

PLATE B-1

PHOTO NO. 2 - UPSTREAM FACE TAKEN FROM THE RIGHT SIDE

PHOTO NO. 3 - UPSTREAM SLOPE AND CREST OF THE SOUTH LEG
TAKEN FROM THE LEFT SIDE

PHOTO NO. 4 - UPSTREAM FACE OF THE SOUTH AND EAST LEGS
TAKEN FROM THE LEFT END OF THE EAST LEG

PHOTO NO. 5 - RIPRAP ON THE SOUTH LEG. IT EXTENDS ABOUT
150 FEET LEFT OF THE SPILLWAY

PHOTO NO. 6 - THE UPSTREAM SLOPE AND CREST OF THE EAST LEG LOOKING NORTH. THE UPSTREAM SLOPE IS BADLY ERODED

PHOTO NO. 7 - DOWNSTREAM CREST OF THE SOUTH LEG LOOKING FROM LEFT TO RIGHT, OR LOOKING TOWARD THE WEST

PHOTO NO. 8 - DOWNSTREAM SLOPE OF THE EAST LEG TAKEN FROM THE LEFT END OF THE SOUTH LEG LOOKING NORTH. COMPLETELY COVERED WITH BRUSH AND TREES.

PHOTO NO. 9 - LOOKING DOWNSTREAM FROM THE LEFT END OF THE SPILLWAY

PHOTO NO. 10 - CREST TAKEN FROM THE RIGHT SIDE

PHOTO NO. 11 - CREST OF THE EAST LEG LOOKING NORTH FROM JUST NORTH OF THE END OF THE SOUTH LEG

PHOTO NO. 12 - A HOLE ERODED IN THE UPSTREAM FACE OF DAM ABOUT 50 FEET FROM THE LEFT END OF THE SOUTH LEG OF THE DAM. IT EXTENDS INTO THE EMBANKMENT ABOUT 3 FEET AND IS APPROX. 10 FEET WIDE.

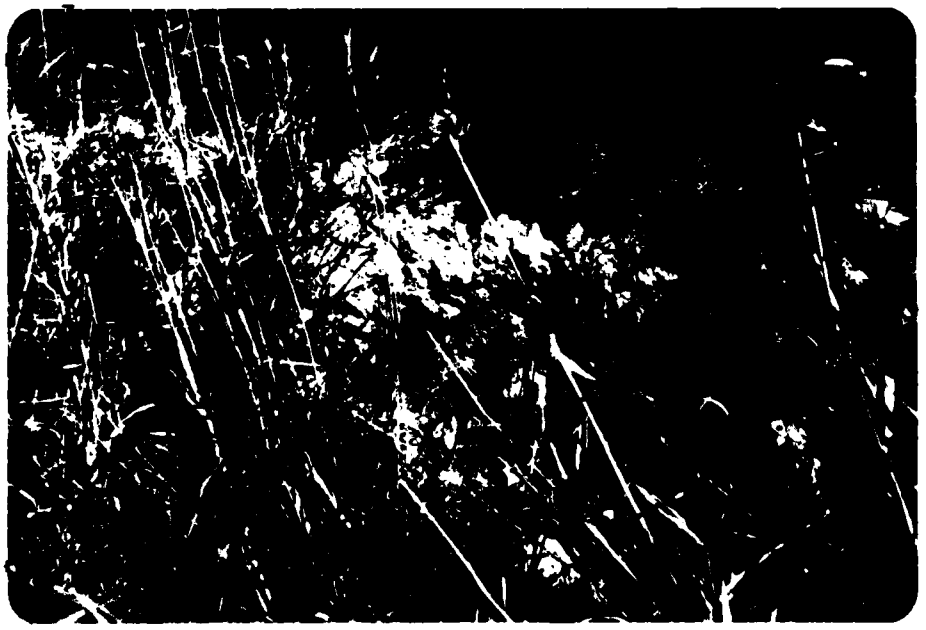


PHOTO NO. 13 - EROSION OF THE UPSTREAM FACE OF THE EAST LEG AT ABOUT STATION 3+75 OR 4+00

PHOTO NO. 14 - EROSION OF CREST OF THE EAST LEG OF THE AREA TAKEN IN PHOTO NO. 15. CREST MEASURES ONLY 3 FEET IN WIDTH AT THIS LOCATION.

PHOTO NO. 15 - EROSION OF THE UPSTREAM FACE AT STATION 3+00

PHOTO NO. 16 - EROSION ACTIVITY ON THE UPSTREAM FACE OF THE EAST LEG

PHOTO NO. 17 - CONCRETE SPILLWAY TAKEN FROM RIGHT END

PHOTO NO. 18 - LOOKING DOWNSTREAM IN THE CHANNEL BELOW THE SPILLWAY

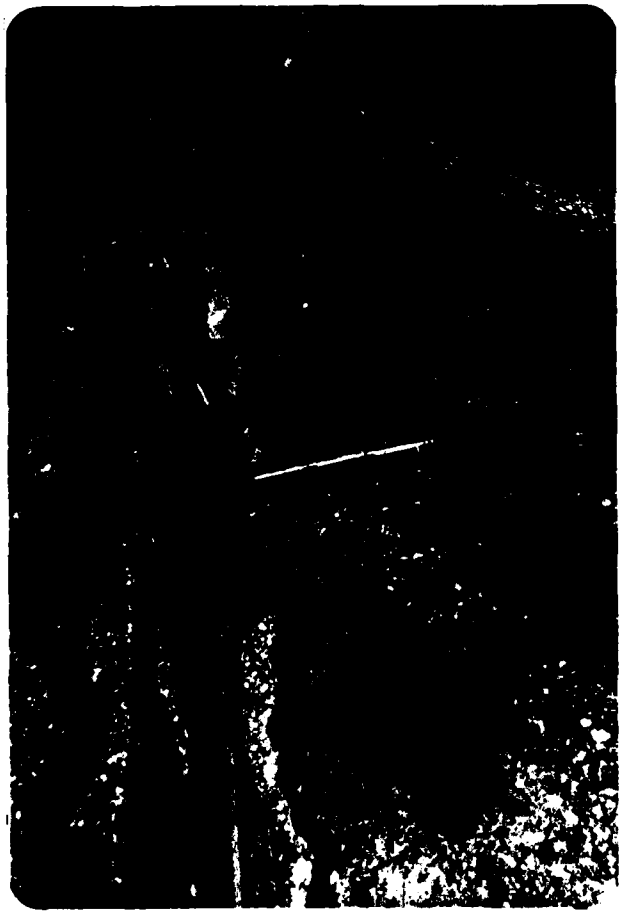


PHOTO NO. 19 - SOME CRACKS IN THE DOWNSTREAM FACE OF THE WEIR SECTION. LOOKS LIKE THE WEIR HAS BEEN PLACED ON AN OLD OGEE SPILL-WAY SECTION.

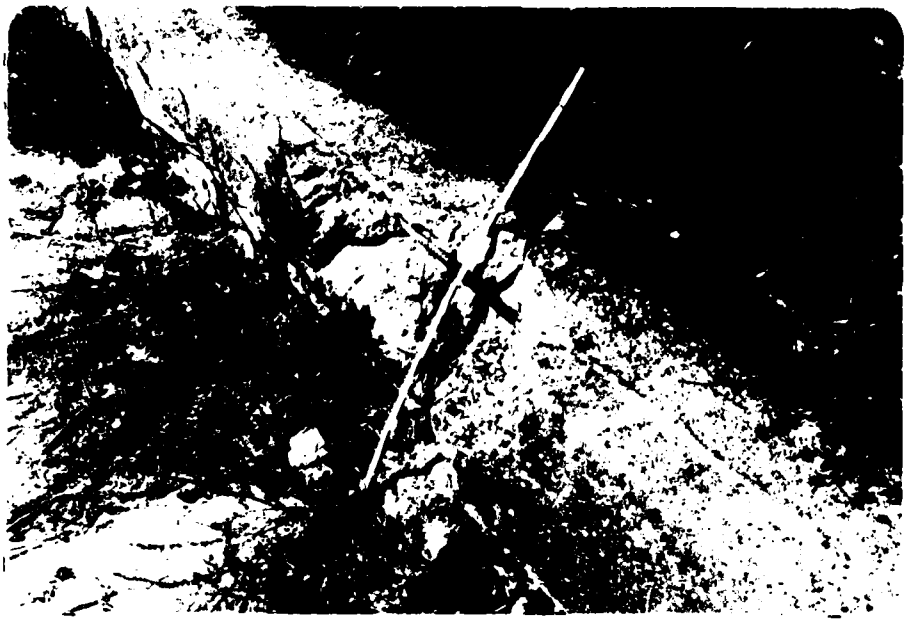


PHOTO NO. 20 - A BAD CRACK EXPOSING REINFORCING STEEL IN THE WEIR SECTION ABOUT 40 FEET FROM THE LEFT END OF THE WEIR

PHOTO NO. 21 - CRACK IN THE OGEE SPILLWAY SECTION ABOUT 40 FEET FROM THE RIGHT END. IT IS ABOUT 2 INCHES WIDE. PHOTO TAKEN LOOKING SOUTH DOWN THE SPILL-WAY.

PHOTO NO. 22 - BEDROCK OUTCROP IN THE CHANNEL ABOUT 100 FEET DOWNSTREAM FROM THE SPILLWAY

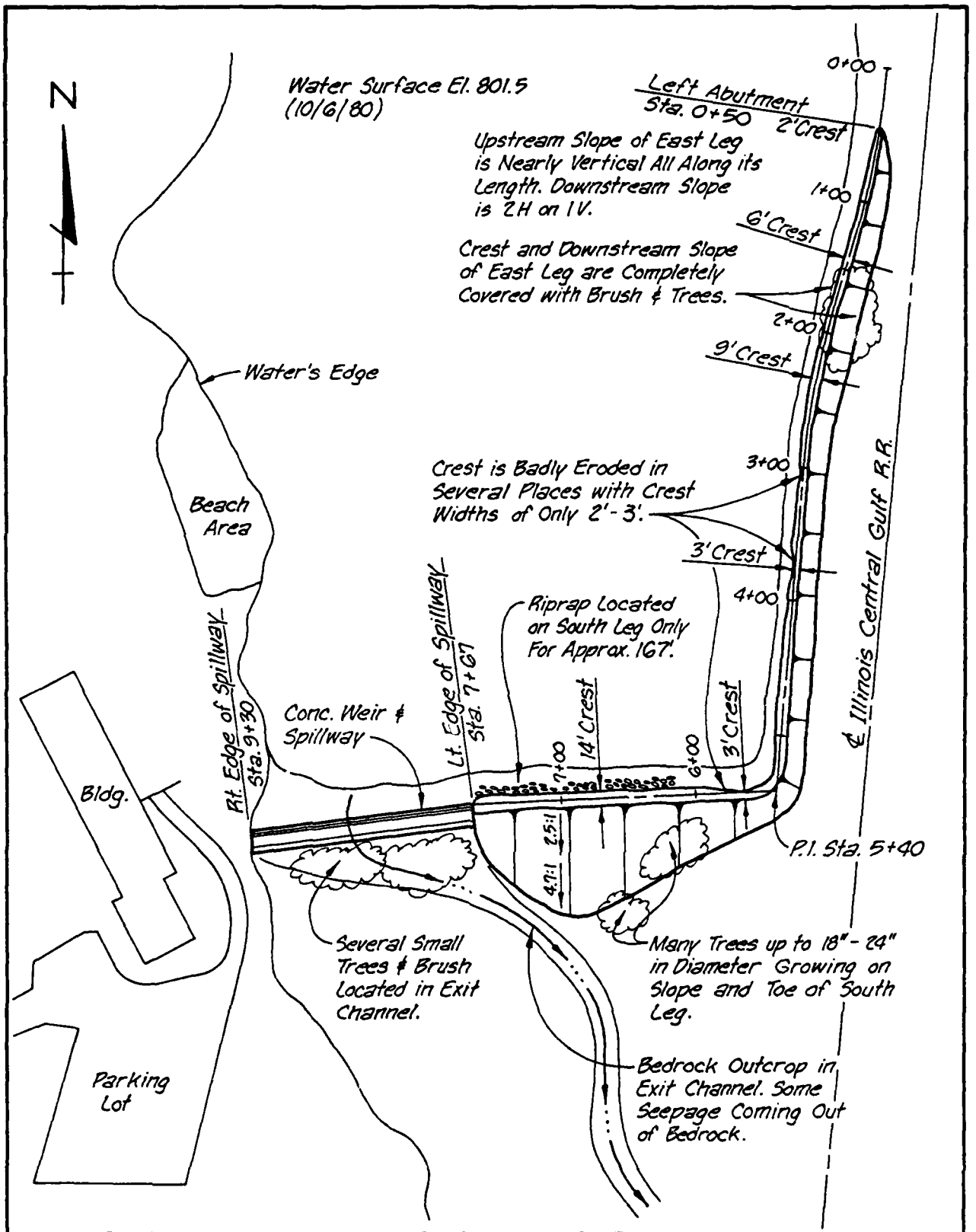
PHOTO NO. 23 - LOOKING UPSTREAM FROM THE LEFT END OF THE SPILLWAY

PHOTO NO. 24 - DWELLING AT APPROXIMATELY 0.2 MILES DOWNSTREAM OF DAM

PHOTO NO. 25 - DWELLING AT 0.3 MILES DOWNSTREAM OF DAM

PHOTO NO. 26 - LOOKING WEST AT LARGE GROCERY STORE APPROXIMATELY 0.25 MILES DOWNSTREAM OF DAM. THE CHANNEL IS TO THE LEFT IN THE PICTURE.

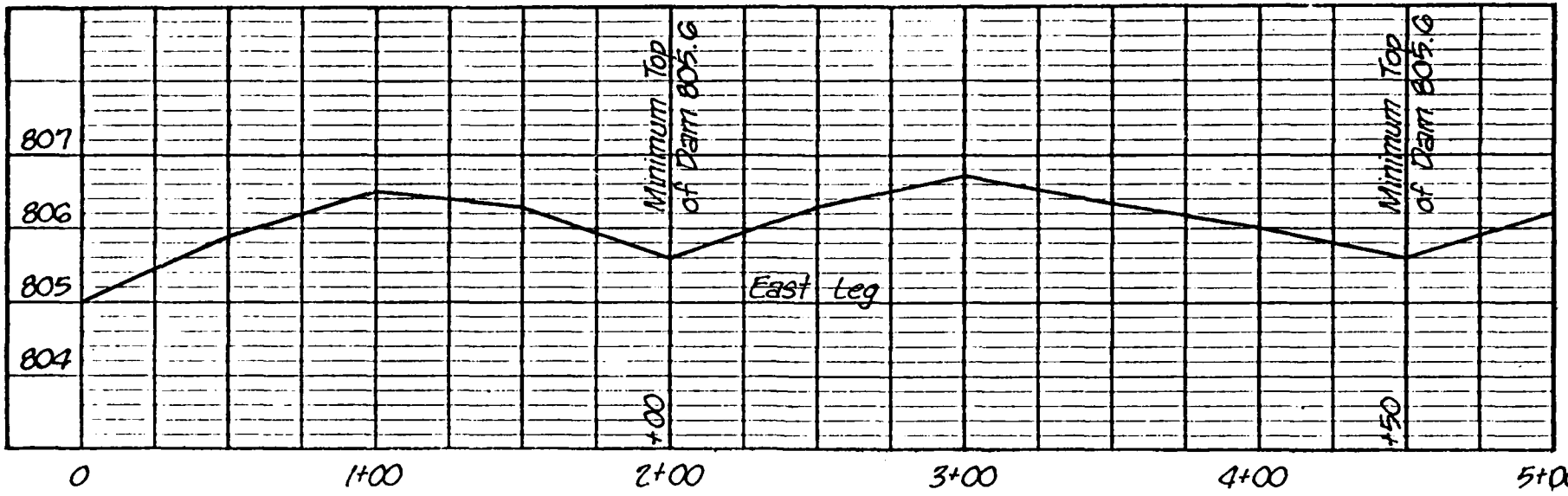
APPENDIX C
PROJECT PLATES



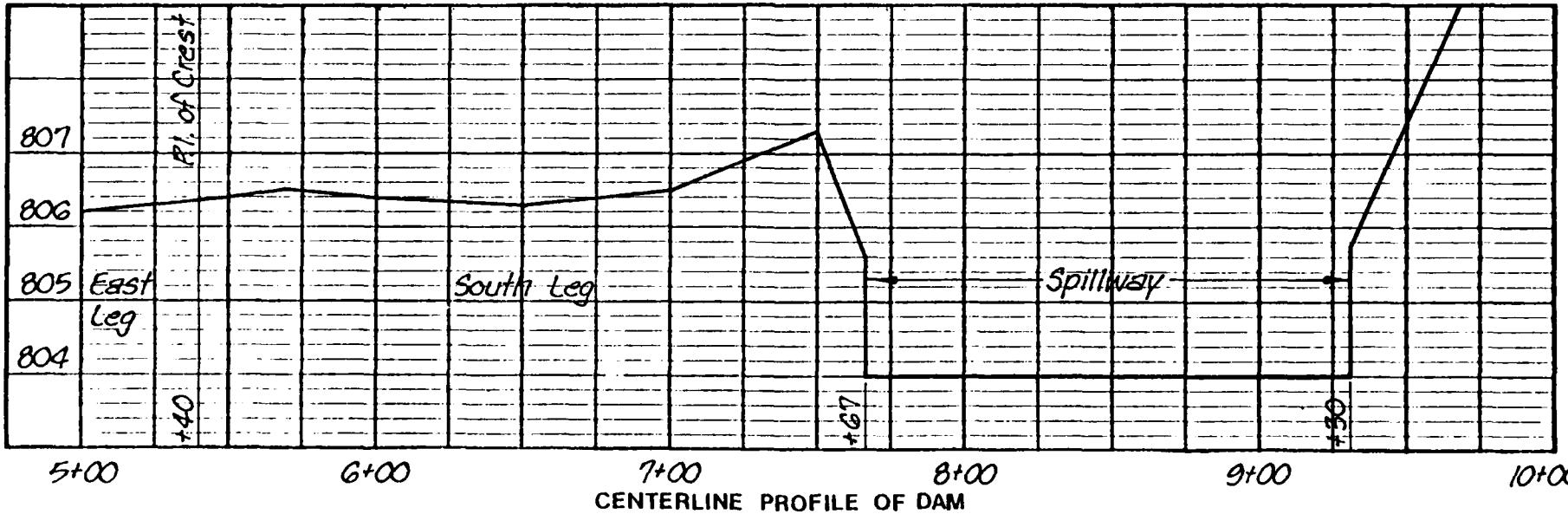
JUNIOR LAKE DAM
CALLAWAY COUNTY, MISSOURI
MO 11526

PLAN OF DAM

PLATE C-1

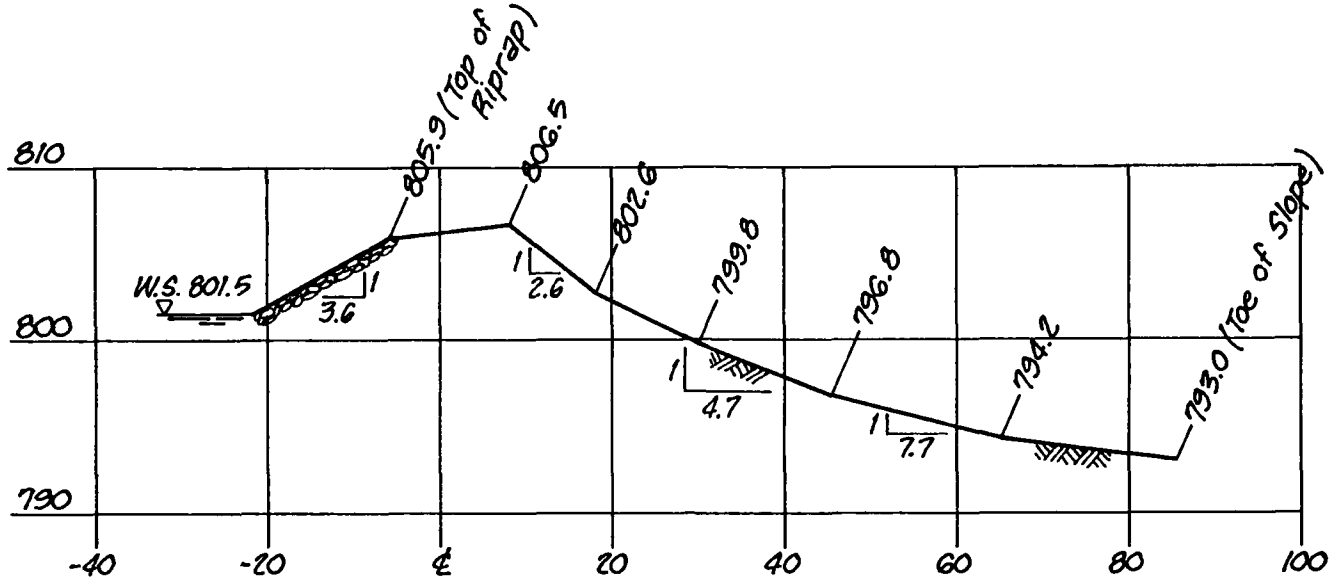


CENTERLINE PROFILE OF DAM
Scale As Shown



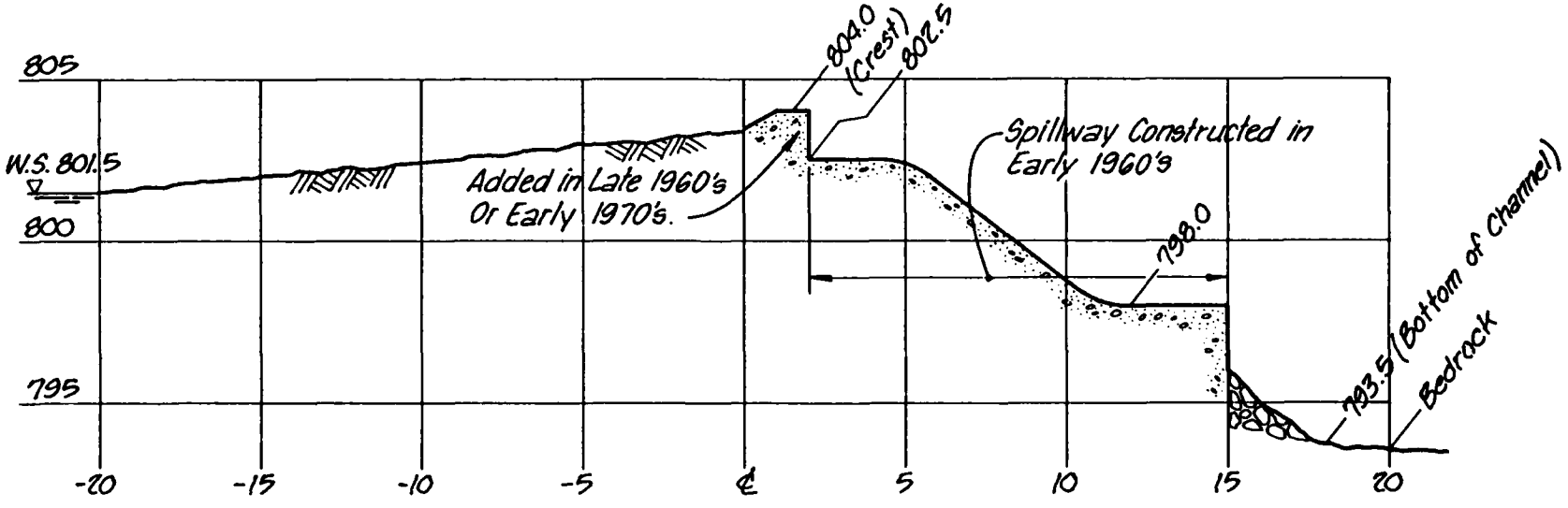
CENTERLINE PROFILE OF DAM
Scale As Shown

PLATE C-2



MAXIMUM CROSS-SECTION OF DAM AT STA. 7+00

Scale: 1" = 20' H.; 1" = 10' V.



PROFILE ALONG CENTERLINE OF SPILLWAY

Scale: 1" = 5' H. & V.

PLATE C-3

APPENDIX D
HYDRAULIC AND HYDROLOGIC DATA

HYDROLOGIC COMPUTATIONS

1. The SCS dimensionless unit hydrograph and the systemized computer program HEC-1 (Dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U.S. Corps of Engineers, Davis, California, were used to develop the inflow hydrographs (See this Appendix).

   a. Forty-eight hour, one percent probabilistic rainfall and ten percent probabilistic rainfall for the dam location was taken from the data for the rainfall station at Moberly, MO. as supplied by the St. Louis District, Corps of Engineers per their letter dated 4 March 1980. The forty-eight hour probable maximum precipitation was taken from the curves of Hydrometeorological Report No. 33 and current Corps of Engineers and St. Louis policy and guidance for hydraulics and hydrology.

   b. Drainage area = 2.89 square miles (1852 acres).

   c. Time of concentration of runoff = 152 minutes (computed from the "Kirpich" formula and verified using the "California Highway Department" method).

   d. The antecedent storm conditions for the probable maximum precipitation were heavy rainfall and low temperatures which occurred on the previous 5 days (SCS AMC III). The antecedent storm conditions for the one and ten percent probabilistic precipitations were an average of the conditions which have preceded the occurrence of the maximum annual flood on numerous watersheds (SCS AMC II). The initial pool elevation was assumed at the crest of the spillway.

   e. The total forty-eight hour storm duration losses for the one percent and ten percent probabilistic storms were 1.44 inches and 1.36 inches respectively. The total losses for the PMF storm were 0.62 inches. These data are based on SCS runoff curve No. 95 and No. 88 for antecedent moisture conditions SCS AMC III and AMC II respectively. The watershed is composed of primarily SCS soil groups Putnam and Mexico (hydrologic soil group D). The majority of the watershed is in cultivated crops which consist of primarily row crops and small grain.

   f. Average soil loss rates = 0.01 inch per hour approximately.

2. The combined discharge rating consisted of two components: the flow through the spillway and the flow over the top of the dam.

   a. The spillway rating was developed using the broad crested weir equation -

      $Q = CLH^{1.5}$

      where C = weir coefficient which varied with head, values ranged from 2.9 to 3.7 (values obtained from Figure 7, "Measurement of Peak Discharge at Dams by Indirect Method", Book 3, Chap. A5, U.S.G.S.)

      L = length of weir, ft. = 163

      H = total head, ft. = pool elevation - 804.0

b. The flows over the dam were developed using the dam overtopping analysis (flow over non-level dam crest) with the HEC-1 (Dam Safety Version) Program.

3. Floods were routed through the reservoir using the HEC-1 (Dam Safety Version) Program to determine the capabilities of the spillway and dam embankment crest. The input, output, and plotted hydrographs are attached in this Appendix.

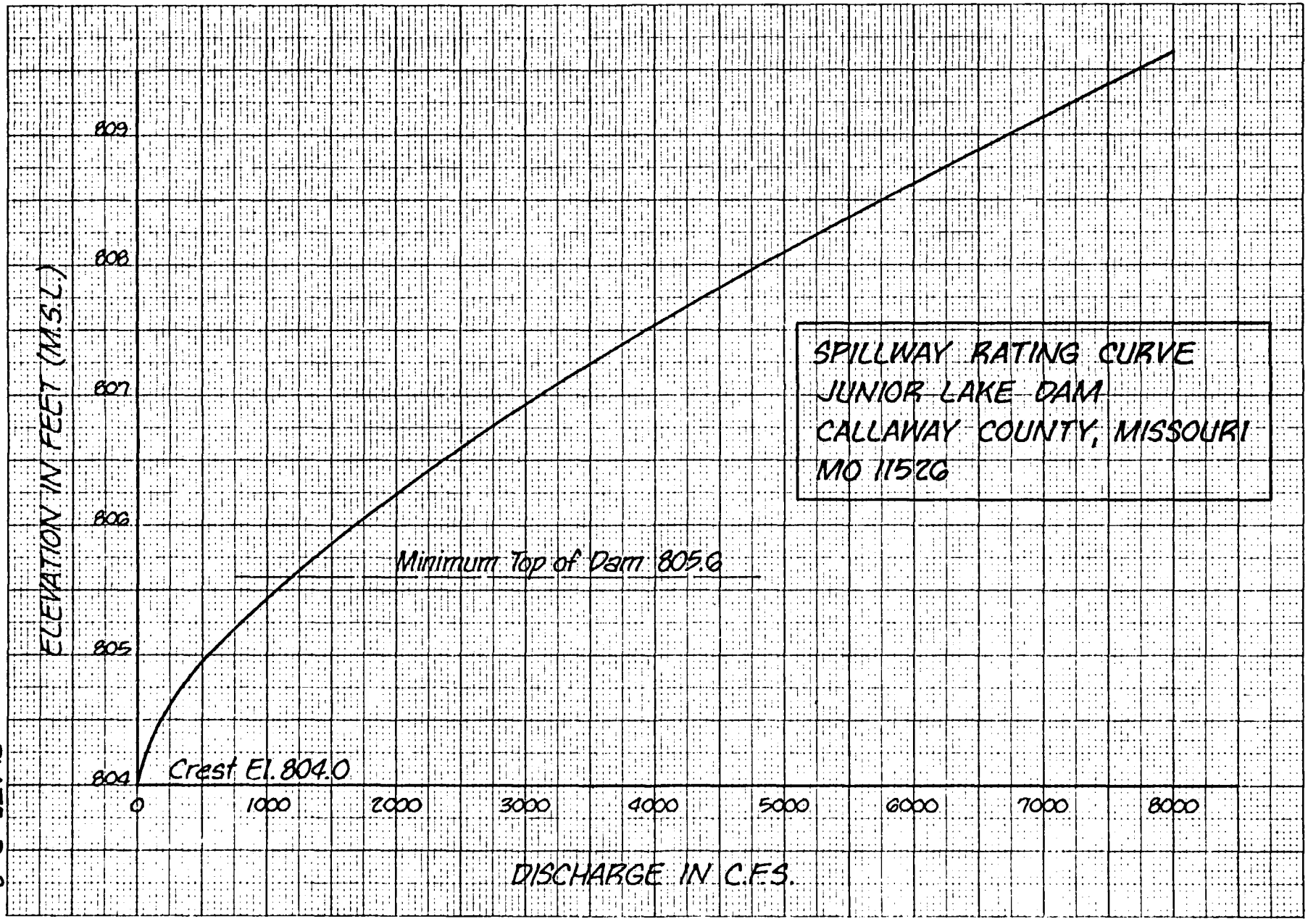
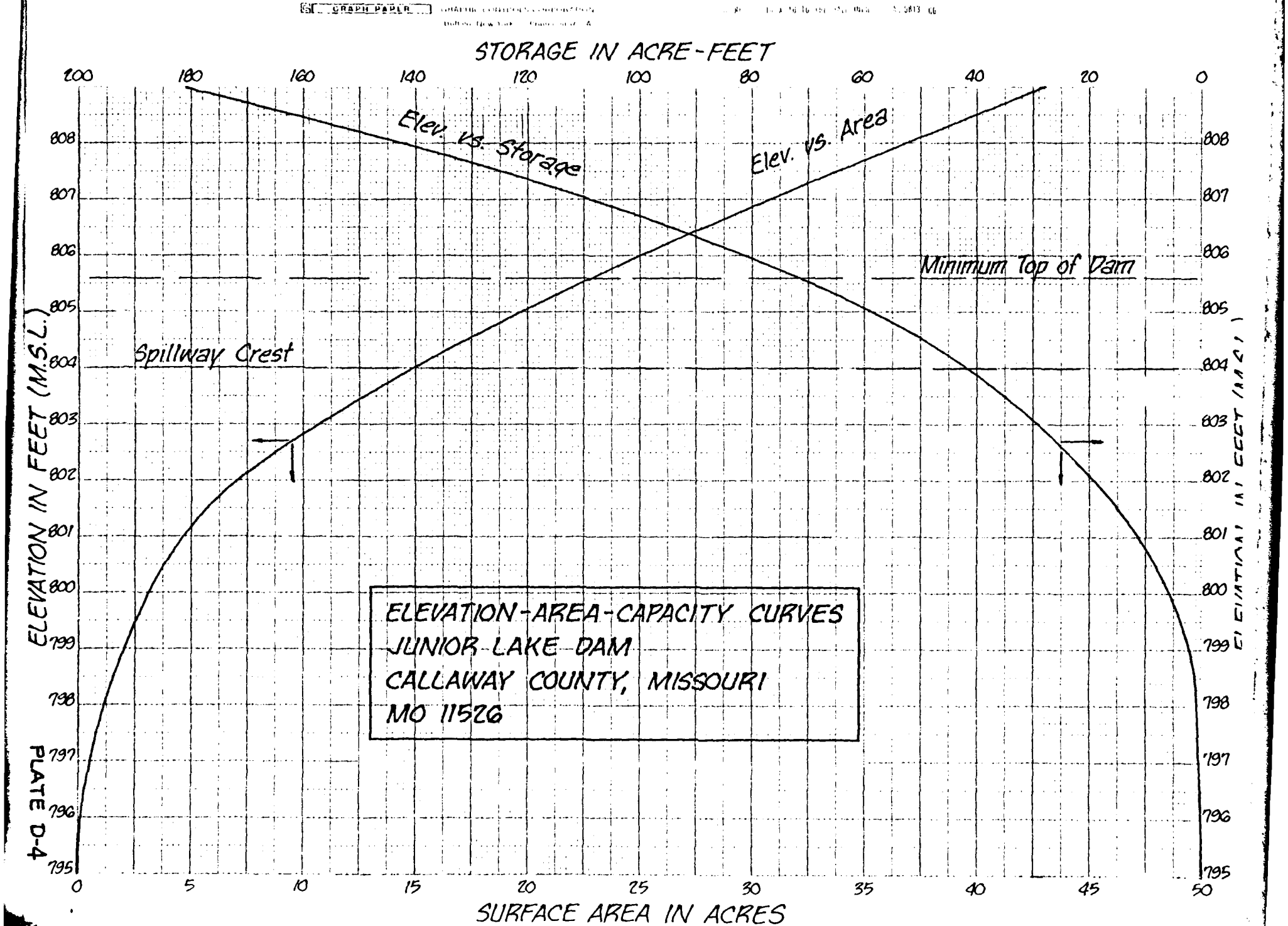


PLATE D-3


STORAGE IN ACRE-FEET
200
180
160
140
120
100
80
60
40
20
0
Elev. vs. Storage
Elev. vs. Area
Minimum Top of Dam
Spillway Crest
ELEVATION IN FEET (M.S.L.)
808
807
806
805
804
803
802
801
800
799
798
797
796
795
0
5
10
15
20
25
30
35
40
45
50
SURFACE AREA IN ACRES
ELEVATION-AREA-CAPACITY CURVES
JUNIOR LAKE DAM
CALLAWAY COUNTY, MISSOURI
MO 11526
PLATE D-4

```
A1              ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
A2              II & II ANALYSIS OF SAFETY OF JUNIOR LAKE DAM 11526
A3              RATIOS OF PMF ROUTED THROUGH THE RESERVOIR
B 000208000000000000012                                  000000000000000000000003
B1000005
J 000001000000800000001
J1000.1000000.1100000.1200000.1300000.1400000.1500000.50000001.0
K 0000000000001                                          000000000000000000000001
K1                CALCULATION OF INFLOW HYDROGRAPH TO RESERVOIR 11526
M 000001000000200002.89                                  00002.89000001.0
P 000000000024.900000102000001210000013000000140
T                                                                    -1.0    -95.0
W2      00001:52
X 000000     -.0100000001
K 0000100000002                                          000000020000000000000001
K1                ROUTED FLOWS THROUGH RESERVOIR 11526
Y                                    1       1
Y1000001                                                            -804.0       -1
Y40804.0000804.5000805.0000805.5000806.0000806.5000807.0000807.5000808.0000808.5
Y40809.0
Y5000000000001740000054100001072000017060000230400003134000039490000482500005757
Y5006743
$A000000000007.1000014.9000043.0
$E000795000801.5000804.0000809.0
$$0004.0
$D0805.6000002.9000001.500000717
$L000000000000320000019700000353000006660000072400000745000007670000076700000767
$V0805.0000805.6000806.0000806.3000806.5000806.7000807.0000807.5000808.0000809.0
K 000099
A
A
A
A
A
```

PLATE D-5

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT 000001
ROUTE HYDROGRAPH TO 000002
END OF NETWORK

PLATE D-6

```
**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********************************

RUN  DATE= 80/11/07.
     TIME= 10.05.40.
```

ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
H & H ANALYSIS OF SAFETY OF JUNIOR LAKE DAM 11526
RATIOS OF PMF ROUTED THROUGH THE RESERVOIR

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	12	0	0	0	0	0	3	0
			JOPER	NWT	LROPT	TRACE			
			5	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 8 LRTIO= 1

RTIOS=	.10	.11	.12	.13	.14	.15	.50	1.00

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

CALCULATION OF INFLOW HYDROGRAPH TO RESERVOIR 11526

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
000001	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	2.89	0.00	2.89	1.00	0.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	24.90	102.00	121.00	130.00	140.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	-1.00	-95.00	0.00	0.00

CURVE NO = -95.00 WETNESS = -1.00 EFFECT CN = 95.00

UNIT HYDROGRAPH DATA
TC= 0.00 LAG= 1.52

RECESSION DATA
STRTQ= 0.00 QRCSN= -.01 RTIOR= 1.00

UNIT HYDROGRAPH 40 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= 1.52 VOL= 1.00

40.	123.	236.	396.	593.	745.	835.	861.	847.	781.
701.	602.	470.	379.	309.	252.	210.	173.	141.	115.
93.	77.	63.	51.	42.	34.	28.	23.	19.	15.
12.	10.	9.	7.	6.	5.	4.	3.	2.	1.

PLATE D-7

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	END-OF-PERIOD FLOW COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.12	1	.00	0.00	.00	0.	1.02	5.00	145	.03	.03	.00	267.
1.01	.24	2	.00	0.00	.00	0.	1.02	5.12	146	.03	.03	.00	268.
1.01	.36	3	.00	0.00	.00	0.	1.02	5.24	147	.03	.03	.00	269.
1.01	.48	4	.00	0.00	.00	0.	1.02	5.36	148	.03	.03	.00	270.
1.01	1.00	5	.00	0.00	.00	0.	1.02	5.48	149	.03	.03	.00	270.
1.01	1.12	6	.00	0.00	.00	0.	1.02	6.00	150	.03	.03	.00	271.
1.01	1.24	7	.00	0.00	.00	0.	1.02	6.12	151	.16	.15	.00	276.
1.01	1.36	8	.00	0.00	.00	0.	1.02	6.24	152	.16	.16	.00	292.
1.01	1.48	9	.00	0.00	.00	0.	1.02	6.36	153	.16	.16	.00	322.
1.01	2.00	10	.00	0.00	.00	0.	1.02	6.48	154	.16	.16	.00	372.
1.01	2.12	11	.00	0.00	.00	0.	1.02	7.00	155	.16	.16	.00	447.
1.01	2.24	12	.00	0.00	.00	0.	1.02	7.12	156	.16	.16	.00	541.
1.01	2.36	13	.00	0.00	.00	0.	1.02	7.24	157	.16	.16	.00	646.
1.01	2.48	14	.00	0.00	.00	0.	1.02	7.36	158	.16	.16	.00	755.
1.01	3.00	15	.00	0.00	.00	0.	1.02	7.48	159	.16	.16	.00	862.
1.01	3.12	16	.00	0.00	.00	0.	1.02	8.00	160	.16	.16	.00	961.
1.01	3.24	17	.00	0.00	.00	0.	1.02	8.12	161	.16	.16	.00	1050.
1.01	3.36	18	.00	0.00	.00	0.	1.02	8.24	162	.16	.16	.00	1126.
1.01	3.48	19	.00	0.00	.00	0.	1.02	8.36	163	.16	.16	.00	1187.
1.01	4.00	20	.00	0.00	.00	0.	1.02	8.48	164	.16	.16	.00	1236.
1.01	4.12	21	.00	0.00	.00	0.	1.02	9.00	165	.16	.16	.00	1276.
1.01	4.24	22	.00	0.00	.00	0.	1.02	9.12	166	.16	.16	.00	1308.
1.01	4.36	23	.00	0.00	.00	0.	1.02	9.24	167	.16	.16	.00	1336.
1.01	4.48	24	.00	0.00	.00	0.	1.02	9.36	168	.16	.16	.00	1358.
1.01	5.00	25	.00	0.00	.00	0.	1.02	9.48	169	.16	.16	.00	1377.
1.01	5.12	26	.00	0.00	.00	0.	1.02	10.00	170	.16	.16	.00	1392.
1.01	5.24	27	.00	0.00	.00	0.	1.02	10.12	171	.16	.16	.00	1404.
1.01	5.36	28	.00	0.00	.00	0.	1.02	10.24	172	.16	.16	.00	1415.
1.01	5.48	29	.00	0.00	.00	0.	1.02	10.36	173	.16	.16	.00	1423.
1.01	6.00	30	.00	0.00	.00	0.	1.02	10.48	174	.16	.16	.00	1430.
1.01	6.12	31	.01	0.00	.01	0.	1.02	11.00	175	.16	.16	.00	1436.
1.01	6.24	32	.01	0.00	.01	0.	1.02	11.12	176	.16	.16	.00	1441.
1.01	6.36	33	.01	.00	.01	0.	1.02	11.24	177	.16	.16	.00	1445.
1.01	6.48	34	.01	.00	.01	0.	1.02	11.36	178	.16	.16	.00	1448.
1.01	7.00	35	.01	.00	.01	0.	1.02	11.48	179	.16	.16	.00	1451.
1.01	7.12	36	.01	.00	.01	0.	1.02	12.00	180	.16	.16	.00	1454.
1.01	7.24	37	.01	.00	.01	1.	1.02	12.12	181	.51	.51	.00	1470.
1.01	7.36	38	.01	.00	.01	1.	1.02	12.24	182	.51	.51	.00	1514.
1.01	7.48	39	.01	.00	.01	2.	1.02	12.36	183	.51	.51	.00	1598.
1.01	8.00	40	.01	.00	.01	3.	1.02	12.48	184	.51	.51	.00	1730.
1.01	8.12	41	.01	.00	.01	5.	1.02	13.00	185	.51	.51	.00	1946.
1.01	8.24	42	.01	.00	.01	7.	1.02	13.12	186	.61	.61	.00	2211.
1.01	8.36	43	.01	.00	.01	9.	1.02	13.24	187	.61	.61	.00	2516.
1.01	8.48	44	.01	.00	.01	12.	1.02	13.36	188	.61	.61	.00	2841.
1.01	9.00	45	.01	.00	.01	14.	1.02	13.48	189	.61	.61	.00	3178.
1.01	9.12	46	.01	.00	.01	17.	1.02	14.00	190	.61	.61	.00	3511.
1.01	9.24	47	.01	.01	.01	20.	1.02	14.12	191	.76	.76	.00	3839.
1.01	9.36	48	.01	.01	.01	23.	1.02	14.24	192	.76	.76	.00	4153.
1.01	9.48	49	.01	.01	.01	26.	1.02	14.36	193	.76	.76	.00	4444.
1.01	10.00	50	.01	.01	.01	29.	1.02	14.48	194	.76	.76	.00	4724.
1.01	10.12	51	.01	.01	.01	32.	1.02	15.00	195	.76	.76	.00	5002.
1.01	10.24	52	.01	.01	.01	35.	1.02	15.12	196	.97	.96	.00	5283.
1.01	10.36	53	.01	.01	.01	37.	1.02	15.24	197	1.74	1.74	.00	5601.
1.01	10.48	54	.01	.01	.01	40.	1.02	15.36	198	4.83	4.82	.00	6108.
1.01	11.00	55	.01	.01	.01	42.	1.02	15.48	199	1.54	1.54	.00	6835.
1.01	11.12	56	.01	.01	.01	45.	1.02	16.00	200	.77	.77	.00	7750.
1.01	11.24	57	.01	.01	.01	47.	1.02	16.12	201	.71	.71	.00	8875.
1.01	11.36	58	.01	.01	.00	49.	1.02	16.24	202	.71	.71	.00	10099.

PLATE D-8

1.01	11.48	59	.01	.01	.00	51.	1.02	16.36	203	.71	.71	.00	11067.
1.01	12.00	60	.01	.01	.00	53.	1.02	16.48	204	.71	.71	.00	11645.
1.01	12.12	61	.04	.02	.01	56.	1.02	17.00	205	.71	.71	.00	11839.
1.01	12.24	62	.04	.03	.01	60.	1.02	17.12	206	.56	.56	.00	11742.
1.01	12.36	63	.04	.03	.01	66.	1.02	17.24	207	.56	.56	.00	11352.
1.01	12.48	64	.04	.03	.01	75.	1.02	17.36	208	.56	.56	.00	10816.
1.01	13.00	65	.04	.03	.01	88.	1.02	17.48	209	.56	.56	.00	10141.
1.01	13.12	66	.05	.04	.01	103.	1.02	18.00	210	.56	.56	.00	9347.
1.01	13.24	67	.05	.04	.01	122.	1.02	18.12	211	.04	.04	.00	8620.
1.01	13.36	68	.05	.04	.01	142.	1.02	18.24	212	.04	.04	.00	7990.
1.01	13.48	69	.05	.04	.01	164.	1.02	18.36	213	.04	.04	.00	7392.
1.01	14.00	70	.05	.04	.01	186.	1.02	18.48	214	.04	.04	.00	6794.
1.01	14.12	71	.06	.05	.01	209.	1.02	19.00	215	.04	.04	.00	6143.
1.01	14.24	72	.06	.05	.01	232.	1.02	19.12	216	.04	.04	.00	5460.
1.01	14.36	73	.06	.05	.01	254.	1.02	19.24	217	.04	.04	.00	4780.
1.01	14.48	74	.06	.05	.01	276.	1.02	19.36	218	.04	.04	.00	4136.
1.01	15.00	75	.06	.05	.01	298.	1.02	19.48	219	.04	.04	.00	3540.
1.01	15.12	76	.07	.07	.01	321.	1.02	20.00	220	.04	.04	.00	3004.
1.01	15.24	77	.13	.12	.01	347.	1.02	20.12	221	.04	.04	.00	2534.
1.01	15.36	78	.37	.34	.03	386.	1.02	20.24	222	.04	.04	.00	2135.
1.01	15.48	79	.12	.11	.01	442.	1.02	20.36	223	.04	.04	.00	1816.
1.01	16.00	80	.06	.06	.00	511.	1.02	20.48	224	.04	.04	.00	1563.
1.01	16.12	81	.05	.05	.00	596.	1.02	21.00	225	.04	.04	.00	1355.
1.01	16.24	82	.05	.05	.00	688.	1.02	21.12	226	.04	.04	.00	1185.
1.01	16.36	83	.05	.05	.00	762.	1.02	21.24	227	.04	.04	.00	1044.
1.01	16.48	84	.05	.05	.00	809.	1.02	21.36	228	.04	.04	.00	928.
1.01	17.00	85	.05	.05	.00	828.	1.02	21.48	229	.04	.04	.00	834.
1.01	17.12	86	.04	.04	.00	826.	1.02	22.00	230	.04	.04	.00	759.
1.01	17.24	87	.04	.04	.00	802.	1.02	22.12	231	.04	.04	.00	697.
1.01	17.36	88	.04	.04	.00	766.	1.02	22.24	232	.04	.04	.00	645.
1.01	17.48	89	.04	.04	.00	723.	1.02	22.36	233	.04	.04	.00	601.
1.01	18.00	90	.04	.04	.00	669.	1.02	22.48	234	.04	.04	.00	565.
1.01	18.12	91	.00	.00	.00	619.	1.02	23.00	235	.04	.04	.00	534.
1.01	18.24	92	.00	.00	.00	576.	1.02	23.12	236	.04	.04	.00	508.
1.01	18.36	93	.00	.00	.00	534.	1.02	23.24	237	.04	.04	.00	486.
1.01	18.48	94	.00	.00	.00	492.	1.02	23.36	238	.04	.04	.00	470.
1.01	19.00	95	.00	.00	.00	446.	1.02	23.48	239	.04	.04	.00	459.
1.01	19.12	96	.00	.00	.00	397.	1.03	0.00	240	.04	.04	.00	450.
1.01	19.24	97	.00	.00	.00	348.	1.03	.12	241	0.00	0.00	0.00	441.
1.01	19.36	98	.00	.00	.00	302.	1.03	.24	242	0.00	0.00	0.00	429.
1.01	19.48	99	.00	.00	.00	258.	1.03	.36	243	0.00	0.00	0.00	414.
1.01	20.00	100	.00	.00	.00	219.	1.03	.48	244	0.00	0.00	0.00	392.
1.01	20.12	101	.00	.00	.00	185.	1.03	1.00	245	0.00	0.00	0.00	362.
1.01	20.24	102	.00	.00	.00	156.	1.03	1.12	246	0.00	0.00	0.00	326.
1.01	20.36	103	.00	.00	.00	133.	1.03	1.24	247	0.00	0.00	0.00	287.
1.01	20.48	104	.00	.00	.00	114.	1.03	1.36	248	0.00	0.00	0.00	247.
1.01	21.00	105	.00	.00	.00	99.	1.03	1.48	249	0.00	0.00	0.00	208.
1.01	21.12	106	.00	.00	.00	87.	1.03	2.00	250	0.00	0.00	0.00	173.
1.01	21.24	107	.00	.00	.00	77.	1.03	2.12	251	0.00	0.00	0.00	142.
1.01	21.36	108	.00	.00	.00	68.	1.03	2.24	252	0.00	0.00	0.00	118.
1.01	21.48	109	.00	.00	.00	61.	1.03	2.36	253	0.00	0.00	0.00	118.
1.01	22.00	110	.00	.00	.00	56.	1.03	2.48	254	0.00	0.00	0.00	118.
1.01	22.12	111	.00	.00	.00	51.	1.03	3.00	255	0.00	0.00	0.00	118.
1.01	22.24	112	.00	.00	.00	48.	1.03	3.12	256	0.00	0.00	0.00	118.
1.01	22.36	113	.00	.00	.00	44.	1.03	3.24	257	0.00	0.00	0.00	118.
1.01	22.48	114	.00	.00	.00	42.	1.03	3.36	258	0.00	0.00	0.00	118.
1.01	23.00	115	.00	.00	.00	40.	1.03	3.48	259	0.00	0.00	0.00	116.
1.01	23.12	116	.00	.00	.00	38.	1.03	4.00	260	0.00	0.00	0.00	116.
1.01	23.24	117	.00	.00	.00	36.	1.03	4.12	261	0.00	0.00	0.00	116.
1.01	23.36	118	.00	.00	.00	35.	1.03	4.24	262	0.00	0.00	0.00	116.
1.01	23.48	119	.00	.00	.00	34.	1.03	4.36	263	0.00	0.00	0.00	116.
1.02	0.00	120	.00	.00	.00	33.	1.03	4.48	264	0.00	0.00	0.00	116.

1.02	.12	121	.03	.03	.00	34.	1.03	5.00	265	0.00	0.00	0.00	0.00	118.
1.02	.24	122	.03	.03	.00	37.	1.03	5.12	266	0.00	0.00	0.00	0.00	118.
1.02	.36	123	.03	.03	.00	42.	1.03	5.24	267	0.00	0.00	0.00	0.00	118.
1.02	.48	124	.03	.03	.00	52.	1.03	5.36	268	0.00	0.00	0.00	0.00	118.
1.02	1.00	125	.03	.03	.00	67.	1.03	5.48	269	0.00	0.00	0.00	0.00	118.
1.02	1.12	126	.03	.03	.00	86.	1.03	6.00	270	0.00	0.00	0.00	0.00	118.
1.02	1.24	127	.03	.03	.00	107.	1.03	6.12	271	0.00	0.00	0.00	0.00	118.
1.02	1.36	128	.03	.03	.00	129.	1.03	6.24	272	0.00	0.00	0.00	0.00	118.
1.02	1.48	129	.03	.03	.00	151.	1.03	6.36	273	0.00	0.00	0.00	0.00	118.
1.02	2.00	130	.03	.03	.00	171.	1.03	6.48	274	0.00	0.00	0.00	0.00	118.
1.02	2.12	131	.03	.03	.00	189.	1.03	7.00	275	0.00	0.00	0.00	0.00	118.
1.02	2.24	132	.03	.03	.00	205.	1.03	7.12	276	0.00	0.00	0.00	0.00	118.
1.02	2.36	133	.03	.03	.00	217.	1.03	7.24	277	0.00	0.00	0.00	0.00	118.
1.02	2.48	134	.03	.03	.00	227.	1.03	7.36	278	0.00	0.00	0.00	0.00	118.
1.02	3.00	135	.03	.03	.00	235.	1.03	7.48	279	0.00	0.00	0.00	0.00	118.
1.02	3.12	136	.03	.03	.00	241.	1.03	8.00	280	0.00	0.00	0.00	0.00	118.
1.02	3.24	137	.03	.03	.00	247.	1.03	8.12	281	0.00	0.00	0.00	0.00	118.
1.02	3.36	138	.03	.03	.00	251.	1.03	8.24	282	0.00	0.00	0.00	0.00	118.
1.02	3.48	139	.03	.03	.00	255.	1.03	8.36	283	0.00	0.00	0.00	0.00	118.
1.02	4.00	140	.03	.03	.00	258.	1.03	8.48	284	0.00	0.00	0.00	0.00	118.
1.02	4.12	141	.03	.03	.00	261.	1.03	9.00	285	0.00	0.00	0.00	0.00	118.
1.02	4.24	142	.03	.03	.00	263.	1.03	9.12	286	0.00	0.00	0.00	0.00	118.
1.02	4.36	143	.03	.03	.00	265.	1.03	9.24	287	0.00	0.00	0.00	0.00	118.
1.02	4.48	144	.03	.03	.00	266.	1.03	9.36	288	0.00	0.00	0.00	0.00	118.
									SUM	35.07	34.44	.62	324774.	
										(891.)	(875.)	(16.)	(9196.58)	

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	11839.	7295.	2511.	1128.	324733.
CMS	335.	207.	71.	32.	9195.
INCHES		23.48	32.33	34.84	34.84
MM		596.41	821.26	884.98	884.98
AC-FT		3617.	4981.	5367.	5367.
THOUS CU M		4462.	6144.	6621.	6621.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 1

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1104.	729.	251.	113.	32473.
CMS	34.	21.	7.	3.	920.
INCHES		2.35	3.23	3.48	3.48
MM		59.64	82.13	88.50	88.50
AC-FT		362.	498.	537.	537.
THOUS CU M		446.	614.	662.	662.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 2

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1302.	802.	276.	124.	35721.
CMS	37.	23.	8.	4.	1011.
INCHES		2.58	3.56	3.83	3.83
MM		65.60	90.34	97.35	97.35
AC-FT		398.	548.	590.	590.
THOUS CU M		491.	676.	728.	728.

PLATE D-10

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	11839.	7295.	2511.	1120.	324733.
CMS	335.	207.	71.	32.	9195.
INCHES		23.40	32.33	34.84	34.84
MM		596.41	821.26	884.98	884.98
AC-FT		3617.	4981.	5367.	5367.
THOUS CU M		4462.	6144.	6621.	6621.

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HYDROGRAPH ROUTING

ROUTED FLOWS THROUGH RESERVOIR 11526

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
000002	1	0	0	2	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-804.	-1

STAGE	804.00 809.00	804.50	805.00	805.50	806.00	806.50	807.00	807.50	808.00	808.50
FLOW	0.00 6743.00	174.00	541.00	1072.00	1706.00	2384.00	3134.00	3949.00	4825.00	5757.00
SURFACE AREA=	0.	7.	15.	43.						
CAPACITY=	0.	15.	42.	181.						
ELEVATION=	795.	802.	804.	809.						

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
804.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
805.6	2.9	1.5	717.

CREST LENGTH	0.	32.	197.	353.	666.	724.	745.	767.	767.	767.
AT OR BELOW ELEVATION	805.0	805.6	806.0	806.3	806.5	806.7	807.0	807.5	808.0	809.0

STATION 000002, PLAN 1, RATIO 1 [0.10 PMF]

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	1.	1.	1.	1.	2.	2.	2.	2.
2.	3.	3.	4.	4.	4.	4.	5.	5.	5.
5.	5.	6.	6.	7.	8.	9.	10.	12.	14.

PLATE D-11

15.	17.	20.	22.	24.	26.	28.	31.	34.	38.
43.	50.	57.	63.	69.	73.	75.	76.	76.	74.
71.	68.	64.	60.	56.	52.	48.	43.	39.	34.
30.	26.	22.	17.	17.	14.	12.	11.	9.	8.
7.	7.	6.	5.	5.	5.	4.	4.	4.	4.
4.	4.	4.	4.	5.	6.	7.	8.	10.	12.
14.	16.	17.	19.	20.	21.	22.	23.	24.	24.
25.	25.	26.	26.	26.	26.	26.	27.	27.	27.
27.	27.	28.	30.	34.	38.	45.	52.	61.	70.
79.	88.	96.	103.	109.	115.	120.	124.	128.	131.
133.	135.	137.	137.	140.	141.	142.	143.	143.	144.
145.	146.	148.	154.	162.	176.	208.	239.	271.	303.
336.	368.	399.	428.	457.	485.	513.	550.	610.	684.
774.	880.	987.	1076.	1140.	1165.	1158.	1126.	1075.	1015.
945.	876.	812.	749.	687.	621.	553.	499.	443.	386.
331.	202.	239.	202.	173.	160.	146.	132.	119.	107.
97.	88.	81.	74.	68.	64.	59.	56.	53.	51.
49.	47.	46.	44.	42.	40.	37.	34.	31.	27.
24.	20.	18.	16.	15.	14.	13.	13.	12.	12.
12.	12.	12.	12.	12.	12.	12.	12.	12.	12.
12.	12.	12.	12.	12.	12.	12.	12.	12.	12.
12.	12.	12.	12.	12.	12.	12.	12.		

STORAGE

42.	42.	42.	42.	42.	42.	42.	42.	42.	42.
42.	42.	42.	42.	42.	42.	42.	42.	42.	42.
42.	42.	42.	42.	42.	42.	42.	42.	42.	42.
42.	42.	42.	42.	42.	42.	42.	42.	42.	42.
42.	42.	42.	42.	42.	42.	42.	42.	42.	42.
42.	42.	42.	42.	42.	42.	42.	42.	42.	42.
43.	43.	43.	43.	43.	43.	43.	43.	43.	43.
43.	43.	43.	43.	43.	43.	44.	44.	44.	44.
44.	44.	45.	45.	45.	45.	46.	46.	46.	46.
45.	45.	45.	45.	45.	45.	44.	44.	44.	44.
44.	43.	43.	43.	43.	43.	43.	43.	43.	43.
43.	43.	43.	43.	43.	42.	42.	42.	42.	42.
42.	42.	42.	42.	42.	43.	43.	43.	43.	43.
43.	43.	43.	43.	43.	43.	43.	43.	43.	43.
43.	43.	43.	43.	43.	43.	43.	43.	43.	43.
43.	43.	44.	44.	44.	44.	44.	45.	45.	45.
46.	46.	47.	47.	47.	47.	48.	48.	48.	48.
48.	48.	48.	49.	49.	49.	49.	49.	49.	49.
49.	49.	49.	49.	50.	50.	51.	52.	53.	53.
54.	55.	56.	56.	57.	58.	59.	60.	61.	62.
64.	66.	68.	70.	71.	71.	71.	70.	69.	68.
67.	66.	64.	63.	62.	61.	60.	58.	57.	55.
54.	53.	52.	51.	50.	50.	49.	48.	48.	47.
47.	46.	46.	46.	45.	45.	45.	45.	45.	45.
44.	44.	44.	44.	44.	44.	44.	44.	44.	43.
43.	43.	43.	43.	43.	43.	43.	43.	43.	43.
43.	43.	43.	43.	43.	43.	43.	43.	43.	43.
43.	43.	43.	43.	43.	43.	43.	43.	43.	43.
43.	48.	43.	43.	43.	43.	43.	43.		

STAGE

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804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0
804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0
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804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0
804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0

804.0	804.1	804.1	804.1	804.1	804.1	804.1	804.1	804.1	804.1
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804.2	804.2	804.2	804.2	804.2	804.1	804.1	804.1	804.1	804.1
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804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0
804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0
804.0	804.0	804.0	804.1	804.1	804.1	804.1	804.1	804.1	804.1
804.1	804.1	804.1	804.1	804.1	804.1	804.1	804.1	804.1	804.1
804.1	804.1	804.1	804.1	804.1	804.1	804.1	804.2	804.2	804.2
804.2	804.3	804.3	804.3	804.3	804.3	804.3	804.4	804.4	804.4
804.4	804.4	804.4	804.4	804.4	804.4	804.4	804.4	804.4	804.4
804.4	804.4	804.4	804.4	804.5	804.5	804.5	804.6	804.6	804.7
804.7	804.8	804.8	804.8	804.9	804.9	805.0	805.0	805.1	805.1
805.2	805.3	805.4	805.5	805.5	805.6	805.6	805.5	805.5	805.4
805.4	805.3	805.3	805.2	805.1	805.1	805.0	804.9	804.9	804.8
804.7	804.6	804.6	804.5	804.5	804.5	804.4	804.4	804.3	804.3
804.3	804.3	804.2	804.2	804.2	804.2	804.2	804.2	804.2	804.1
804.1	804.1	804.1	804.1	804.1	804.1	804.1	804.1	804.1	804.1
804.1	804.1	804.1	804.0	804.0	804.0	804.0	804.0	804.0	804.0
804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0
804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0
804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0		

PEAK OUTFLOW IS 1165. AT TIME 41.20 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1165.	726.	251.	113.	32430.
CMS	33.	21.	7.	3.	918.
INCHES		2.34	3.23	3.48	3.48
MM		59.39	82.04	88.38	88.38
AC-FT		360.	498.	536.	536.
THOUS CU M		444.	614.	661.	661.

PLATE D-13

DVF

STATION000002 0.10 PMF

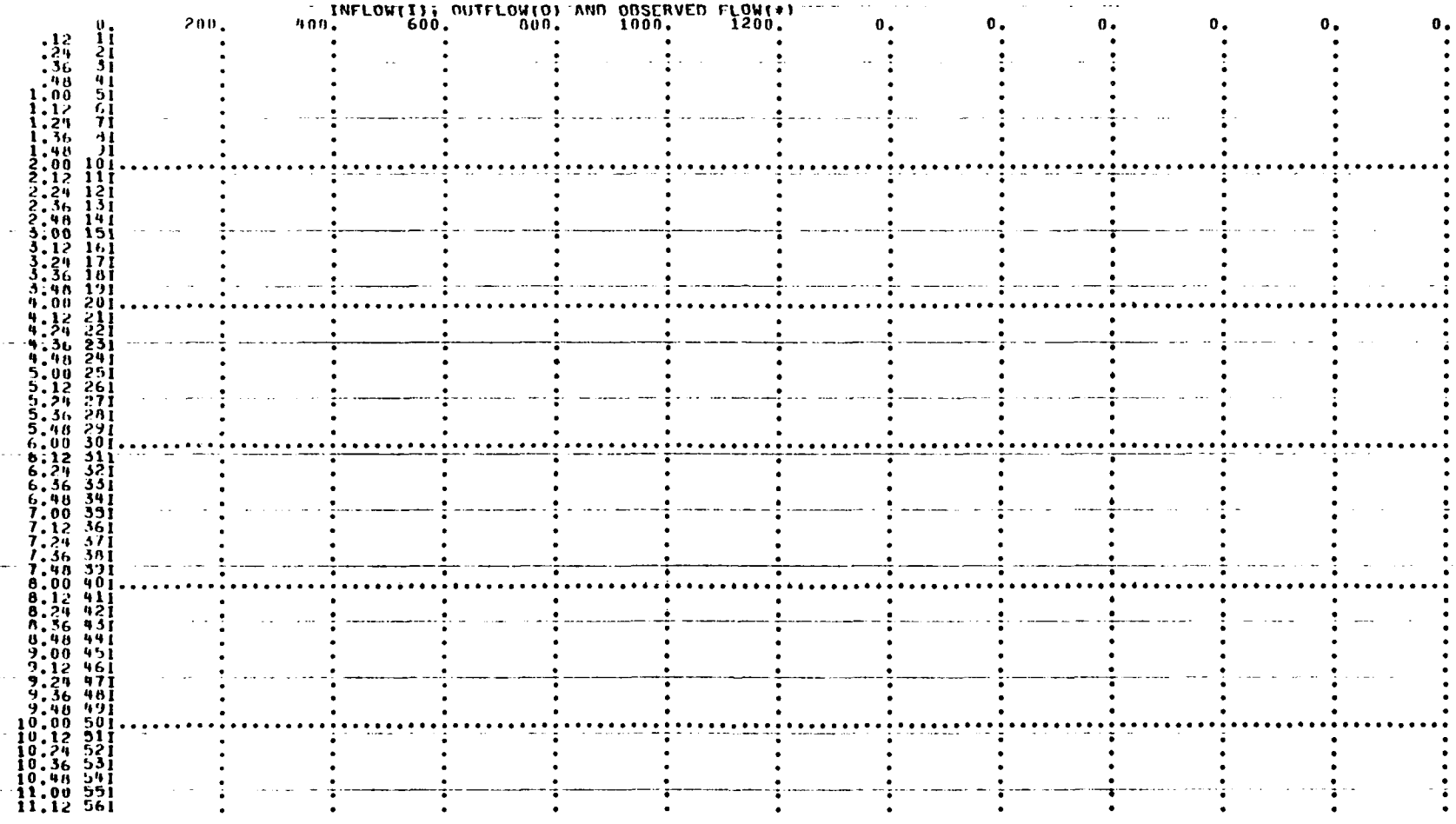


PLATE D-14

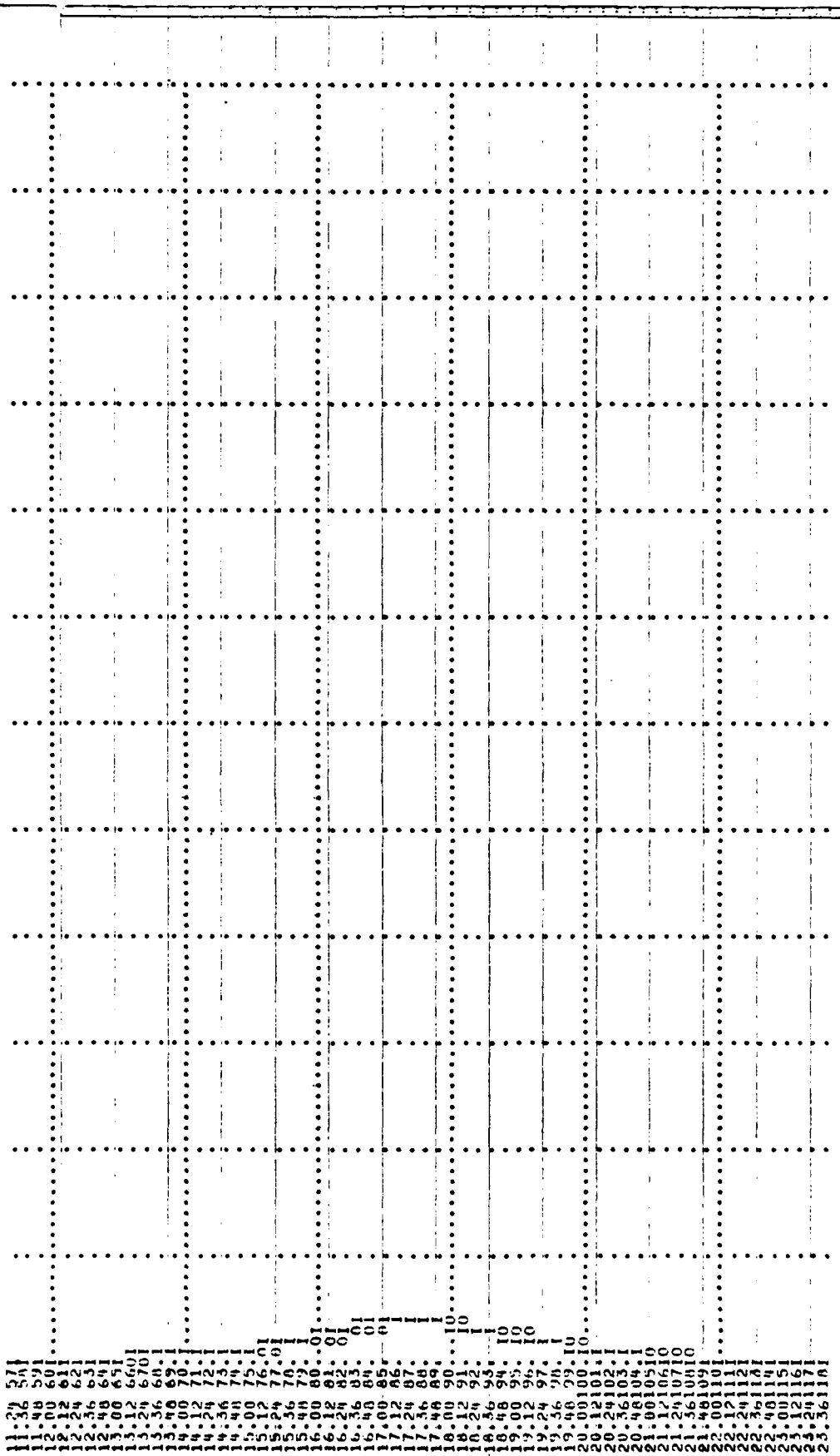
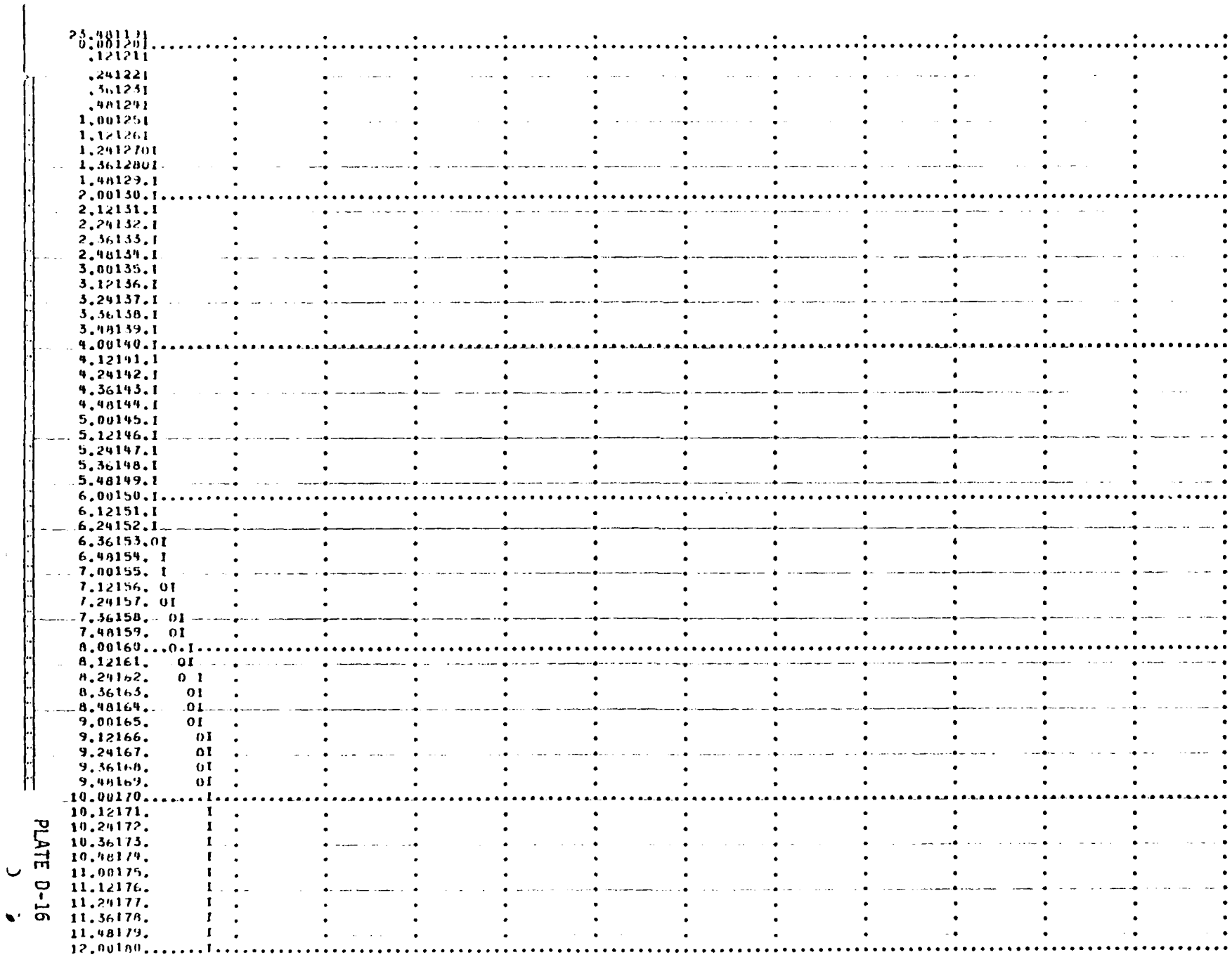


PLATE D-15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2.24132
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3.12136
3.24137
3.36138
3.48139
4.00140
4.12141
4.24142
4.36143
4.48144
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8.36163
8.48164
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9.12166
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9.48169
10.00170
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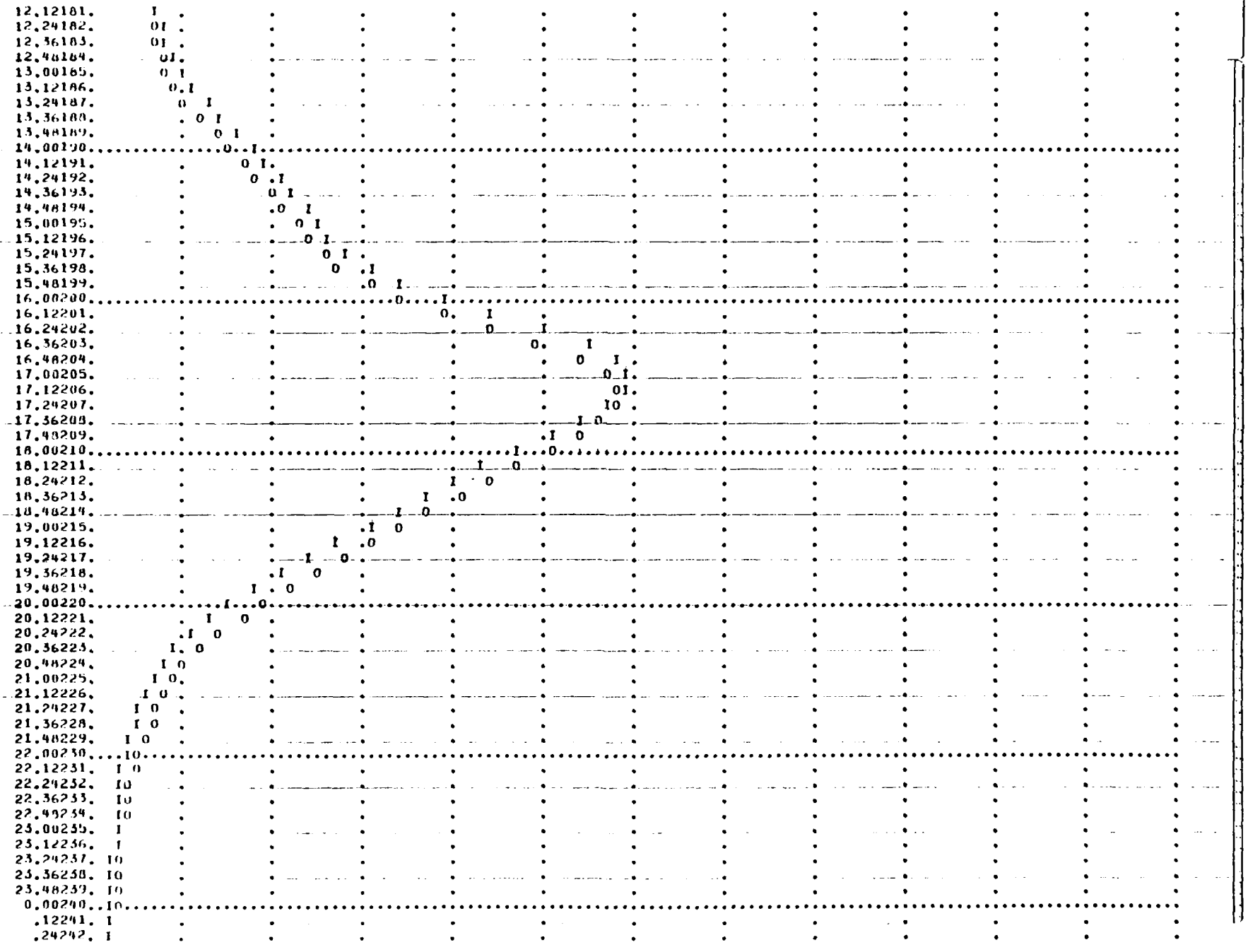
11.48179
12.00180

PLATE D-16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15,12196.
15,24197.
15,36198.
15,48199.
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16,12201.
16,24202.
16,36203.
16,48204.
17,00205.
17,12206.
17,24207.
17,36208.
17,48209.
18,00210.
18,12211.
18,24212.
18,36213.
18,48214.
19,00215.
19,12216.
19,24217.
19,36218.
19,48219.
20,00220.
20,12221.
20,24222.
20,36223.
20,48224.
21,00225.
21,12226.
21,24227.
21,36228.
21,48229.
22,00230.
22,12231.
22,24232.
22,36233.
22,48234.
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23,24237.
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,24242.

PLATE D-17

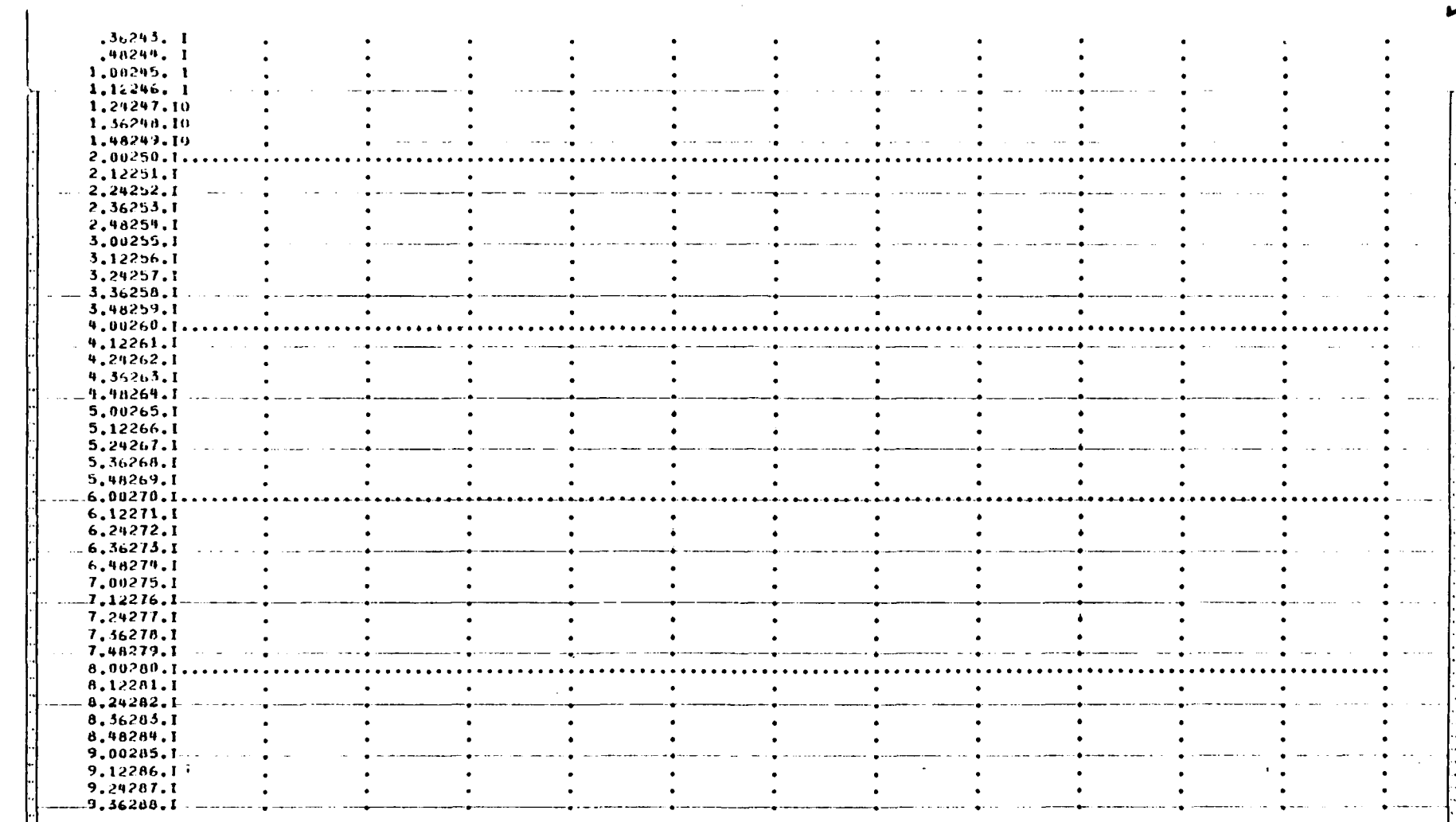
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PLATE D-18

OVN

STATION 000002, PLAN 1, RATIO 7 [0.5 PMF]

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	1.
1.	2.	2.	3.	4.	5.	7.	8.	9.	11.
12.	14.	15.	16.	18.	19.	20.	21.	23.	24.
25.	26.	28.	30.	33.	38.	43.	50.	58.	67.
76.	86.	97.	108.	118.	129.	140.	153.	169.	201.
240.	282.	323.	358.	383.	397.	402.	397.	386.	367.
345.	323.	301.	279.	257.	234.	210.	186.	167.	153.
138.	122.	107.	94.	81.	71.	62.	54.	48.	42.
38.	34.	30.	28.	25.	24.	22.	21.	20.	19.
18.	18.	19.	20.	23.	28.	34.	42.	50.	59.
68.	77.	85.	93.	99.	105.	110.	114.	118.	121.
123.	125.	127.	129.	130.	131.	132.	133.	133.	134.
135.	137.	141.	150.	166.	202.	251.	302.	353.	404.
453.	497.	536.	578.	608.	631.	649.	664.	676.	686.
694.	700.	706.	710.	714.	717.	720.	722.	724.	725.
729.	739.	762.	806.	875.	974.	1100.	1259.	1424.	1595.
1767.	1941.	2105.	2257.	2402.	2546.	2701.	2910.	3234.	3662.
4191.	4797.	5354.	5723.	5890.	5896.	5758.	5512.	5203.	4831.
4457.	4126.	3825.	3531.	3225.	2903.	2590.	2284.	1990.	1724.
1486.	1271.	1083.	941.	813.	705.	614.	540.	492.	446.
406.	371.	341.	317.	296.	278.	264.	251.	242.	234.
228.	223.	217.	209.	199.	185.	171.	160.	147.	132.
116.	101.	88.	80.	74.	69.	66.	64.	63.	62.
61.	60.	60.	60.	60.	59.	59.	59.	59.	59.
59.	59.	59.	59.	59.	59.	59.	59.	59.	59.
59.	59.	59.	59.	59.	59.	59.	59.		

STORAGE

42.	42.	42.	42.	42.	42.	42.	42.	42.	42.
42.	42.	42.	42.	42.	42.	42.	42.	42.	42.
42.	42.	42.	42.	42.	42.	42.	42.	42.	42.
42.	42.	42.	42.	42.	42.	42.	42.	42.	42.
42.	42.	42.	42.	42.	43.	43.	43.	43.	43.
43.	43.	43.	43.	43.	43.	43.	43.	43.	43.
43.	43.	43.	44.	44.	44.	44.	44.	45.	45.
46.	46.	47.	47.	48.	48.	49.	49.	50.	51.
52.	53.	54.	55.	55.	56.	56.	56.	55.	55.
54.	54.	53.	53.	52.	52.	51.	51.	50.	49.
49.	48.	47.	46.	46.	45.	45.	44.	44.	44.
44.	44.	44.	43.	43.	43.	43.	43.	43.	43.
43.	43.	43.	43.	43.	43.	44.	44.	44.	45.
45.	46.	46.	46.	47.	47.	47.	47.	48.	48.
48.	48.	48.	48.	48.	48.	48.	48.	48.	48.
48.	48.	49.	49.	50.	51.	52.	53.	55.	56.
57.	58.	59.	60.	61.	61.	61.	62.	62.	62.
62.	62.	62.	63.	63.	63.	63.	63.	63.	63.
63.	63.	63.	64.	66.	68.	70.	73.	75.	78.
81.	83.	85.	87.	89.	90.	92.	94.	96.	100.
104.	108.	111.	114.	115.	115.	114.	112.	110.	108.
105.	103.	101.	99.	96.	94.	91.	87.	84.	80.
76.	73.	70.	67.	64.	62.	61.	59.	58.	57.
56.	55.	54.	54.	53.	53.	52.	52.	52.	52.

PLATE D-19

52.	51.	51.	51.	51.	51.	50.	50.	49.	48.
47.	47.	46.	46.	46.	45.	45.	45.	45.	45.
45.	45.	45.	45.	45.	45.	45.	45.	45.	45.
45.	45.	45.	45.	45.	45.	45.	45.	45.	45.
45.	45.	45.	45.	45.	45.	45.	45.		

STAGE

804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0
804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0
804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0
804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0
804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0
804.0	804.0	804.0	804.0	804.1	804.1	804.1	804.1	804.1	804.1
804.1	804.1	804.1	804.1	804.1	804.1	804.1	804.1	804.2	804.2
804.2	804.2	804.3	804.3	804.3	804.4	804.4	804.4	804.5	804.5
804.6	804.6	804.7	804.8	804.8	804.8	804.8	804.8	804.8	804.8
804.7	804.7	804.7	804.6	804.6	804.6	804.5	804.5	804.5	804.4
804.4	804.4	804.3	804.3	804.2	804.2	804.2	804.2	804.1	804.1
804.1	804.1	804.1	804.1	804.1	804.1	804.1	804.1	804.1	804.1
804.1	804.1	804.1	804.1	804.1	804.1	804.1	804.1	804.1	804.2
804.2	804.2	804.2	804.3	804.3	804.3	804.3	804.3	804.3	804.3
804.4	804.4	804.4	804.4	804.4	804.4	804.4	804.4	804.4	804.4
804.4	804.4	804.4	804.4	804.5	804.5	804.6	804.7	804.7	804.8
804.9	804.9	805.0	805.0	805.1	805.1	805.1	805.1	805.1	805.1
805.1	805.1	805.2	805.2	805.2	805.2	805.2	805.2	805.2	805.2
805.2	805.2	805.2	805.2	805.3	805.4	805.5	805.6	805.8	805.9
806.0	806.1	806.2	806.2	806.3	806.4	806.4	806.5	806.6	806.7
806.8	807.0	807.1	807.2	807.2	807.2	807.2	807.1	807.1	807.0
806.9	806.8	806.7	806.7	806.6	806.5	806.4	806.2	806.1	805.9
805.8	805.6	805.5	805.4	805.3	805.2	805.1	805.0	804.9	804.9
804.8	804.8	804.7	804.7	804.7	804.6	804.6	804.6	804.6	804.6
804.6	804.6	804.6	804.5	804.5	804.5	804.5	804.5	804.4	804.4
804.3	804.3	804.3	804.2	804.2	804.2	804.2	804.2	804.2	804.2
804.2	804.2	804.2	804.2	804.2	804.2	804.2	804.2	804.2	804.2
804.2	804.2	804.2	804.2	804.2	804.2	804.2	804.2	804.2	804.2
804.2	804.2	804.2	804.2	804.2	804.2	804.2	804.2		

PEAK OUTFLOW IS 5896. AT TIME 41.20 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	5896.	3642.	1255.	563.	162202.
CMS	167.	103.	36.	16.	4593.
INCHES		11.72	16.16	17.40	17.40
MM		297.79	410.34	442.04	442.04
AC-FT		1806.	2489.	2681.	2681.
THOUS CU M		2228.	3070.	3307.	3307.

OVF

STATION000002 [0.51 MI]

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

0. 1000. 2000. 3000. 4000. 5000. 6000. 0. 0. 0. 0. 0. 0.

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.24 21
.36 31
.48 41
1.00 51
1.12 61
1.24 71
1.36 81
1.48 91
2.00 101
2.12 111
2.24 121
2.36 131
2.48 141
3.00 151
3.12 161
3.24 171
3.36 181
3.48 191
4.00 201
4.12 211
4.24 221
4.36 231
4.48 241
5.00 251
5.12 261
5.24 271
5.36 281
5.48 291
6.00 301
6.12 311
6.24 321
6.36 331
6.48 341
7.00 351
7.12 361
7.24 371
7.36 381
7.48 391
8.00 401
8.12 411
8.24 421
8.36 431
8.48 441
9.00 451
9.12 461
9.24 471
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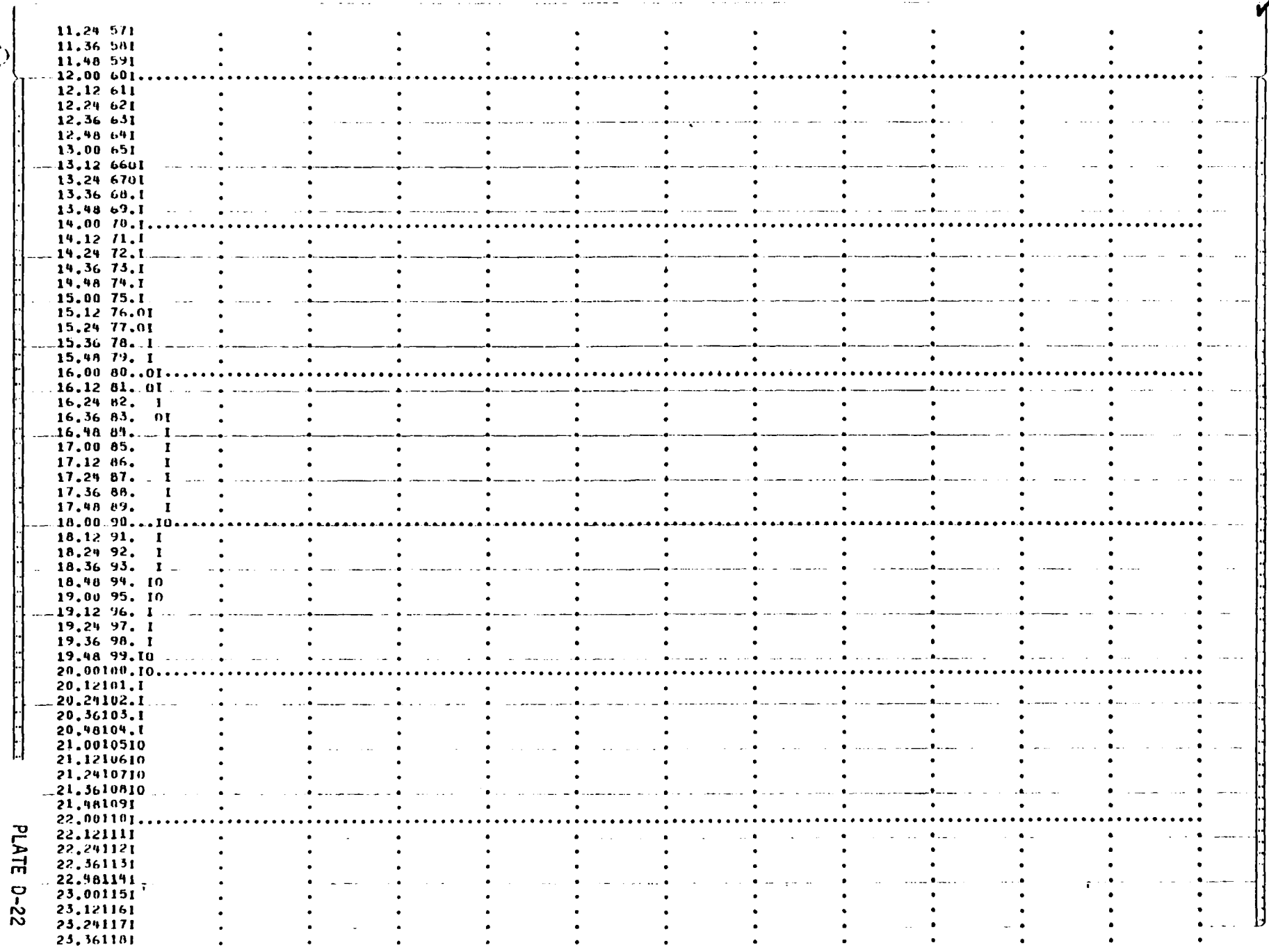
11.12 561

PLATE D-21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13.12 66OI
13.24 67OI
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13.48 69.I
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14.24 72.I
14.36 73.I
14.48 74.I
15.00 75.I
15.12 76.OI
15.24 77.OI
15.36 78. I
15.48 79. I
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16.12 81..OI
16.24 82. I
16.36 83. OI
16.48 84. I
17.00 85. I
17.12 86. I
17.24 87. I
17.36 88. I
17.48 89. I
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18.12 91. I
18.24 92. I
18.36 93. I
18.48 94. IO
19.00 95. IO
19.12 96. I
19.24 97. I
19.36 98. I
19.48 99.IO
20.00100.IO
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20.24102.I
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21.48109I
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PLATE D-22

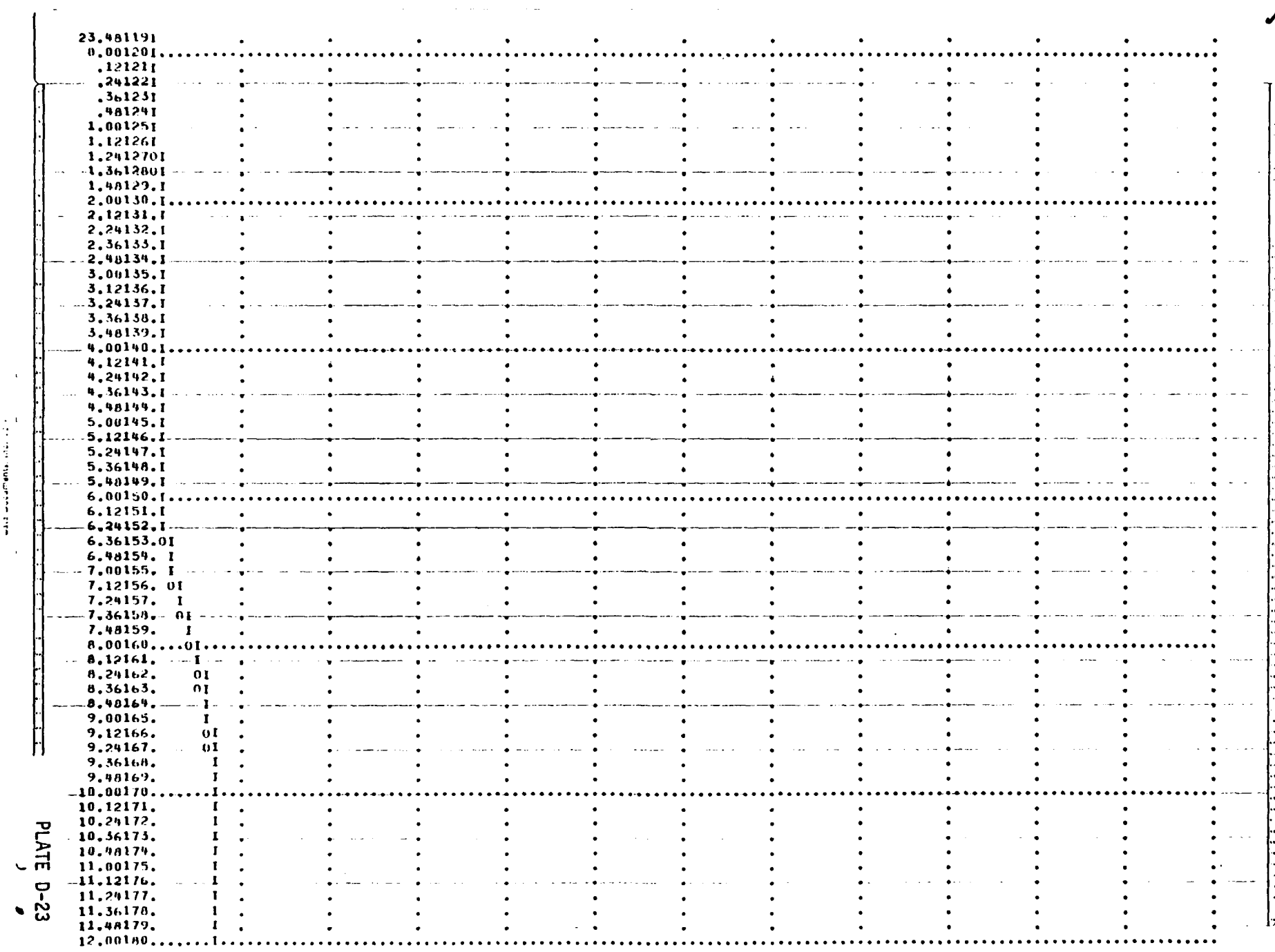
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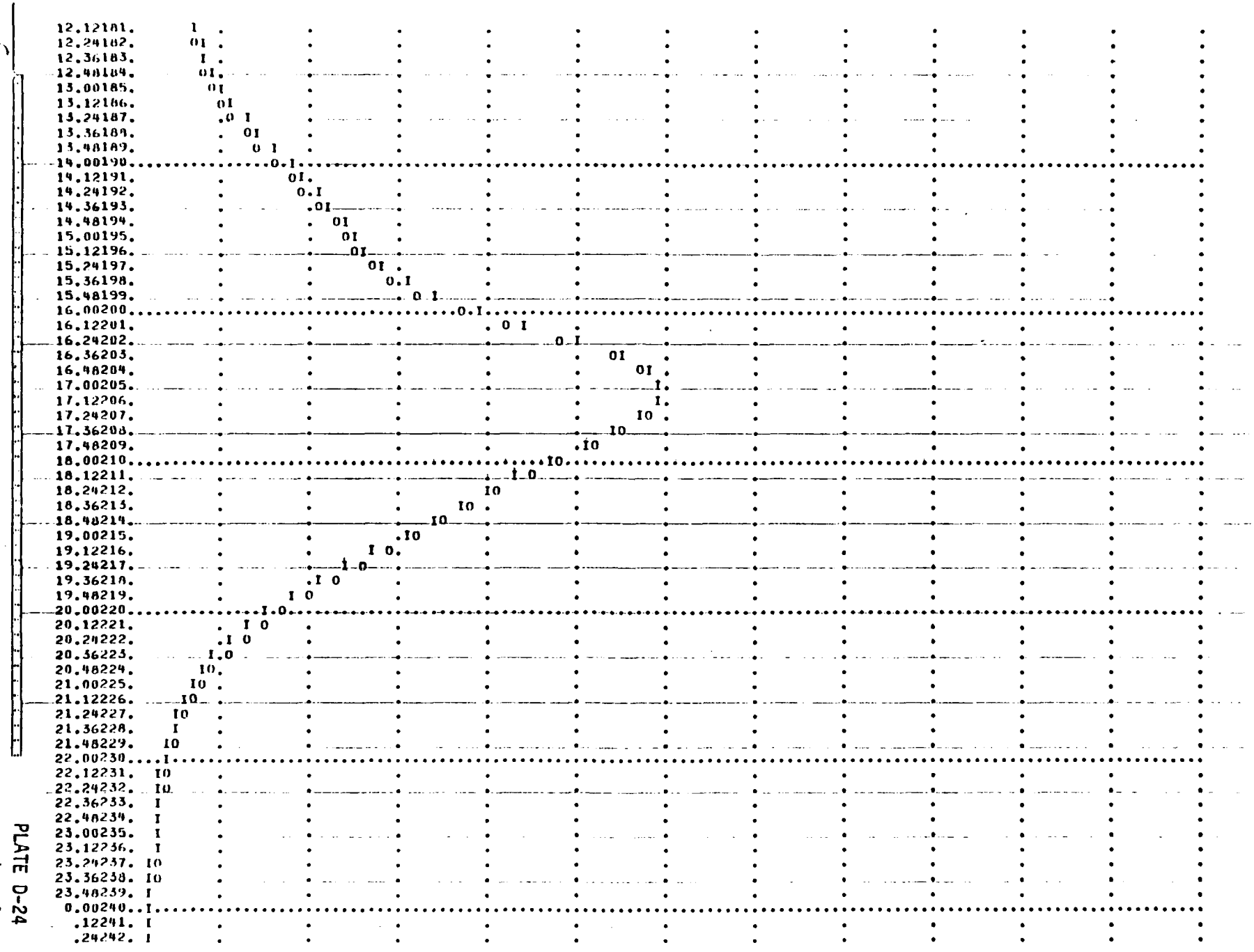
PLATE D-23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15.36198.
15.48199.
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16.12201.
16.24202.
16.36203.
16.48204.
17.00205.
17.12206.
17.24207.
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17.48209.
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19.36218.
19.48219.
20.00220.
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20.24222.
20.36223.
20.48224.
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21.24227.
21.36228.
21.48229.
22.00230.
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22.36233.
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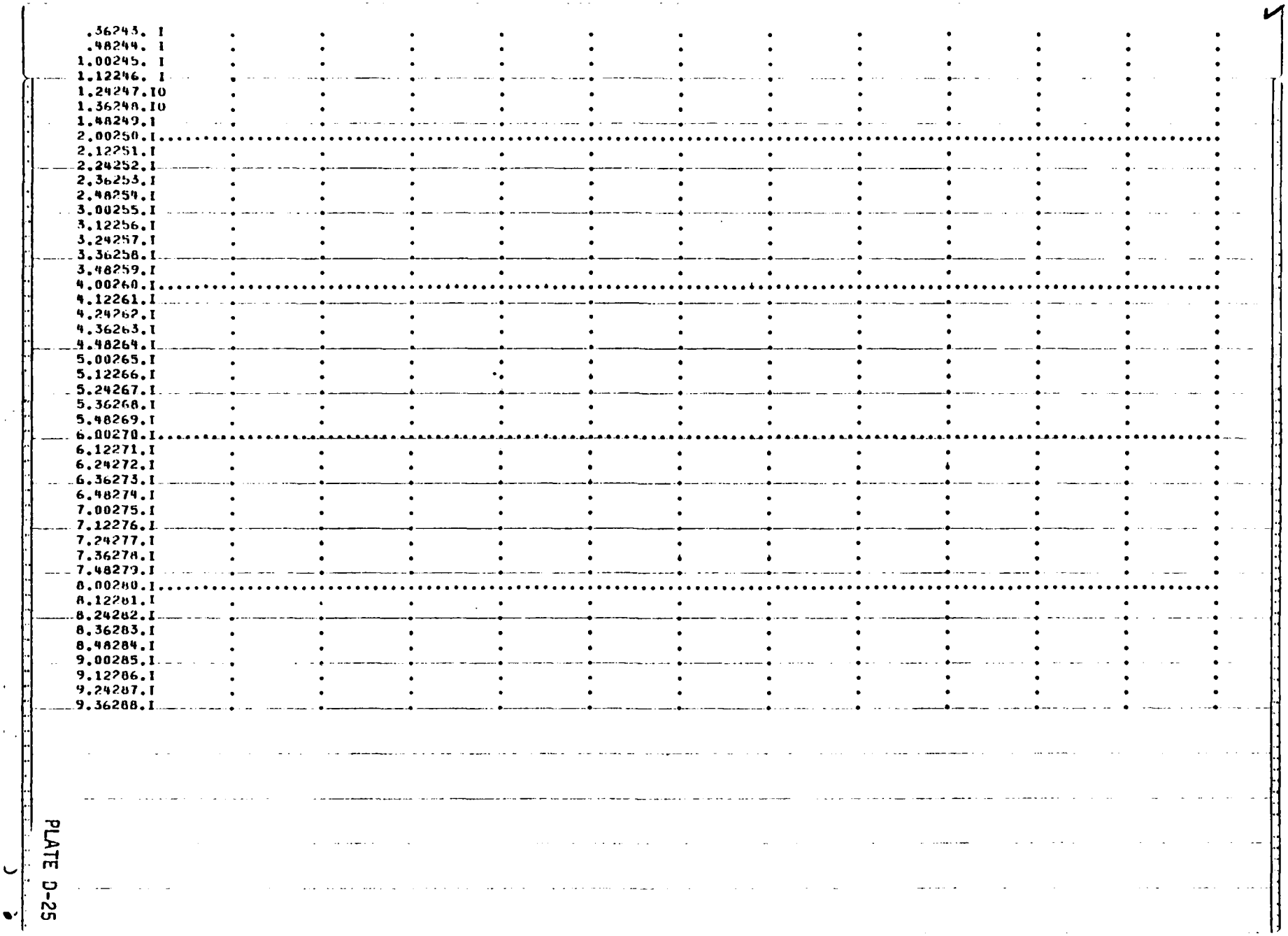
.24242.

PLATE D-24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9.12286.I
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9.36288.I

PLATE D-25

•OVII•

STATION 000002, PLAN 1, RATIO 8 [1.0 PMF]

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	1.	1.
2.	3.	5.	7.	9.	11.	13.	16.	19.	21.
24.	27.	30.	32.	35.	38.	40.	43.	45.	47.
49.	52.	55.	60.	66.	75.	86.	100.	116.	134.
153.	172.	208.	236.	262.	285.	309.	338.	376.	426.
480.	560.	665.	739.	787.	811.	813.	796.	766.	723.
675.	627.	583.	541.	506.	465.	420.	373.	326.	282.
241.	205.	174.	159.	144.	129.	115.	102.	91.	81.
73.	66.	60.	55.	51.	47.	44.	42.	39.	38.
36.	36.	37.	40.	46.	55.	68.	84.	101.	119.
137.	155.	171.	195.	213.	226.	235.	242.	248.	252.
256.	259.	261.	263.	265.	266.	267.	268.	269.	270.
272.	278.	292.	320.	365.	429.	509.	618.	735.	842.
940.	1029.	1108.	1177.	1229.	1271.	1303.	1331.	1354.	1373.
1389.	1402.	1413.	1422.	1429.	1435.	1440.	1444.	1448.	1451.
1458.	1480.	1532.	1627.	1780.	2008.	2295.	2622.	2981.	3348.
3689.	4016.	4322.	4609.	4889.	5174.	5478.	5908.	6556.	7411.
8474.	9676.	10758.	11476.	11793.	11790.	11500.	11001.	10375.	9624.
8863.	8202.	7599.	7009.	6384.	5715.	5040.	4396.	3794.	3250.
2780.	2389.	2052.	1774.	1551.	1359.	1196.	1059.	953.	859.
780.	713.	658.	612.	574.	542.	521.	501.	484.	470.
459.	448.	435.	420.	400.	372.	339.	303.	265.	227.
191.	166.	152.	142.	135.	131.	127.	125.	123.	122.
121.	120.	120.	119.	119.	119.	119.	119.	119.	119.
118.	118.	118.	118.	118.	118.	118.	118.	118.	118.
118.	118.	118.	118.	118.	118.	118.	118.		

STORAGE

42.	42.	42.	42.	42.	42.	42.	42.	42.	42.
42.	42.	42.	42.	42.	42.	42.	42.	42.	42.
42.	42.	42.	42.	42.	42.	42.	42.	42.	42.
42.	42.	42.	42.	42.	42.	42.	42.	42.	42.
42.	42.	42.	43.	43.	43.	43.	43.	43.	43.
43.	43.	44.	44.	44.	44.	44.	44.	44.	44.
44.	45.	45.	45.	45.	46.	46.	47.	48.	48.
49.	50.	51.	52.	52.	53.	53.	54.	55.	56.
58.	60.	62.	63.	64.	64.	64.	64.	64.	63.
62.	61.	60.	59.	58.	57.	56.	55.	54.	53.
52.	51.	50.	50.	49.	48.	47.	47.	46.	46.
46.	45.	45.	45.	45.	44.	44.	44.	44.	44.
44.	44.	44.	44.	44.	45.	45.	46.	47.	48.
48.	49.	50.	51.	51.	51.	52.	52.	52.	52.
52.	52.	52.	52.	52.	52.	52.	52.	53.	53.
53.	53.	53.	54.	55.	56.	59.	61.	63.	65.
67.	69.	70.	71.	72.	73.	73.	74.	74.	74.
75.	75.	75.	75.	75.	75.	76.	76.	76.	76.
76.	76.	77.	78.	81.	84.	87.	91.	94.	97.
100.	102.	104.	106.	108.	110.	112.	115.	119.	124.
130.	137.	143.	147.	148.	148.	147.	144.	141.	136.
132.	128.	125.	121.	118.	114.	109.	105.	101.	97.
93.	88.	84.	81.	77.	74.	72.	69.	67.	65.
64.	63.	62.	61.	60.	59.	59.	58.	58.	58.

PLATE D-26

57.	57.	57.	56.	56.	55.	54.	53.	52.	52.
51.	50.	49.	49.	48.	48.	48.	48.	48.	48.
48.	48.	48.	48.	48.	48.	48.	48.	48.	48.
48.	48.	48.	48.	48.	48.	48.	48.	48.	48.
48.	48.	48.	48.	48.	48.	48.	48.		

STAGE

804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0
804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0
804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0
804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0
804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.0	804.1	804.1
804.1	804.1	804.1	804.1	804.1	804.1	804.1	804.1	804.1	804.1
804.1	804.1	804.2	804.2	804.2	804.2	804.2	804.3	804.3	804.4
804.4	804.5	804.5	804.6	804.6	804.7	804.7	804.7	804.8	804.8
804.9	805.0	805.1	805.2	805.2	805.3	805.3	805.2	805.2	805.2
805.1	805.1	805.0	805.0	805.0	804.9	804.8	804.8	804.7	804.6
804.6	804.5	804.5	804.5	804.4	804.4	804.3	804.3	804.3	804.2
804.2	804.2	804.2	804.2	804.1	804.1	804.1	804.1	804.1	804.1
804.1	804.1	804.1	804.1	804.1	804.2	804.2	804.2	804.3	804.3
804.4	804.4	804.5	804.5	804.6	804.6	804.6	804.6	804.6	804.6
804.6	804.6	804.6	804.6	804.6	804.6	804.6	804.6	804.6	804.6
804.6	804.6	804.7	804.7	804.8	804.8	805.0	805.1	805.2	805.3
805.4	805.5	805.5	805.6	805.6	805.6	805.7	805.7	805.7	805.7
805.7	805.7	805.7	805.7	805.8	805.8	805.8	805.8	805.8	805.8
805.8	805.8	805.8	805.9	806.0	806.1	806.2	806.4	806.5	806.6
806.7	806.8	806.9	806.9	807.0	807.1	807.1	807.2	807.3	807.5
807.7	807.9	808.0	808.1	808.2	808.2	808.1	808.1	808.0	807.9
807.7	807.6	807.5	807.4	807.3	807.2	807.0	806.9	806.7	806.6
806.4	806.3	806.1	806.0	805.8	805.7	805.6	805.5	805.4	805.3
805.2	805.2	805.1	805.1	805.0	805.0	805.0	804.9	804.9	804.9
804.9	804.9	804.9	804.8	804.8	804.8	804.7	804.7	804.6	804.6
804.5	804.5	804.4	804.4	804.4	804.4	804.4	804.4	804.4	804.3
804.3	804.3	804.3	804.3	804.3	804.3	804.3	804.3	804.3	804.3
804.3	804.3	804.3	804.3	804.3	804.3	804.3	804.3	804.3	804.3
804.3	804.3	804.3	804.3	804.3	804.3	804.3	804.3		

PEAK OUTFLOW IS 11793. AT TIME 41.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	11793.	7294.	2510.	1126.	324405.
CMS	334.	207.	71.	32.	9186.
INCHES		23.48	32.32	34.81	34.81
MM		596.34	820.91	884.08	884.08
AC-FT		3617.	4979.	5362.	5362.
THOUS CU M		4461.	6141.	6614.	6614.

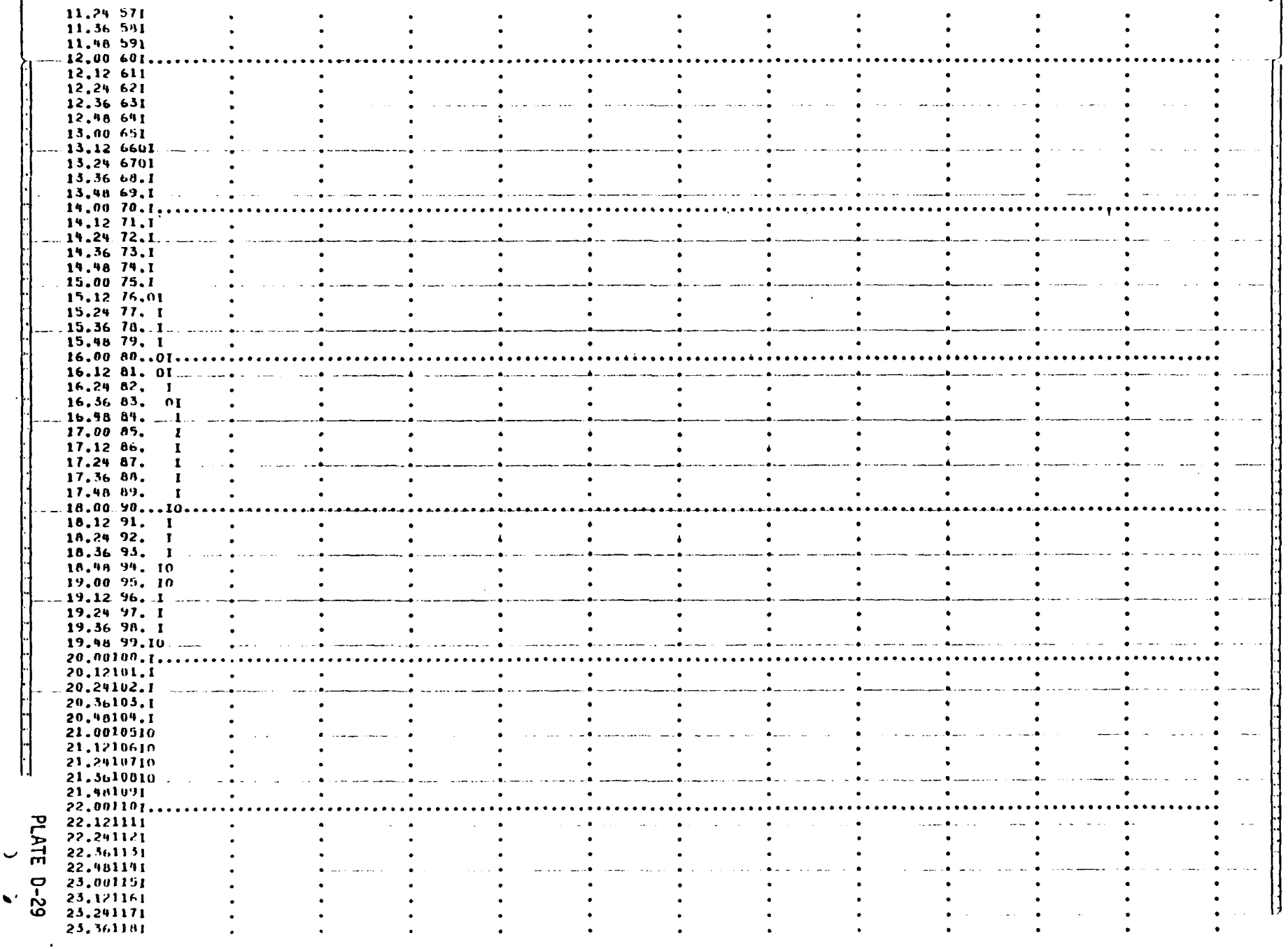
OVF

STATION000002 1.0 PMF

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

	0.	2000.	4000.	6000.	8000.	10000.	12000.	0.	0.	0.	0.	0.	0.
.12	1I												
.24	2I												
.36	3I												
.48	4I												
1.00	5I												
1.12	6I												
1.24	7I												
1.36	8I												
1.48	9I												
2.00	10I												
2.12	11I												
2.24	12I												
2.36	13I												
2.48	14I												
3.00	15I												
3.12	16I												
3.24	17I												
3.36	18I												
3.48	19I												
4.00	20I												
4.12	21I												
4.24	22I												
4.36	23I												
4.48	24I												
5.00	25I												
5.12	26I												
5.24	27I												
5.36	28I												
5.48	29I												
6.00	30I												
6.12	31I												
6.24	32I												
6.36	33I												
6.48	34I												
7.00	35I												
7.12	36I												
7.24	37I												
7.36	38I												
7.48	39I												
8.00	40I												
8.12	41I												
8.24	42I												
8.36	43I												
8.48	44I												
9.00	45I												
9.12	46I												
9.24	47I												
9.36	48I												
9.48	49I												
10.00	50I												
10.12	51I												
10.24	52I												
10.36	53I												
10.48	54I												
11.00	55I												
11.12	56I												

PLATE D-28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12.12 61I
12.24 62I
12.36 63I
12.48 64I
13.00 65I
13.12 66OI
13.24 67OI
13.36 68.I
13.48 69.I
14.00 70.I
14.12 71.I
14.24 72.I
14.36 73.I
14.48 74.I
15.00 75.I
15.12 76.OI
15.24 77. I
15.36 78. I
15.48 79. I
16.00 80..OI
16.12 81. OI
16.24 82. I
16.36 83. OI
16.48 84. I
17.00 85. I
17.12 86. I
17.24 87. I
17.36 88. I
17.48 89. I
18.00 90...IO
18.12 91. I
18.24 92. I
18.36 93. I
18.48 94. IO
19.00 95. IO
19.12 96. I
19.24 97. I
19.36 98. I
19.48 99.IO
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22.001101
22.121111
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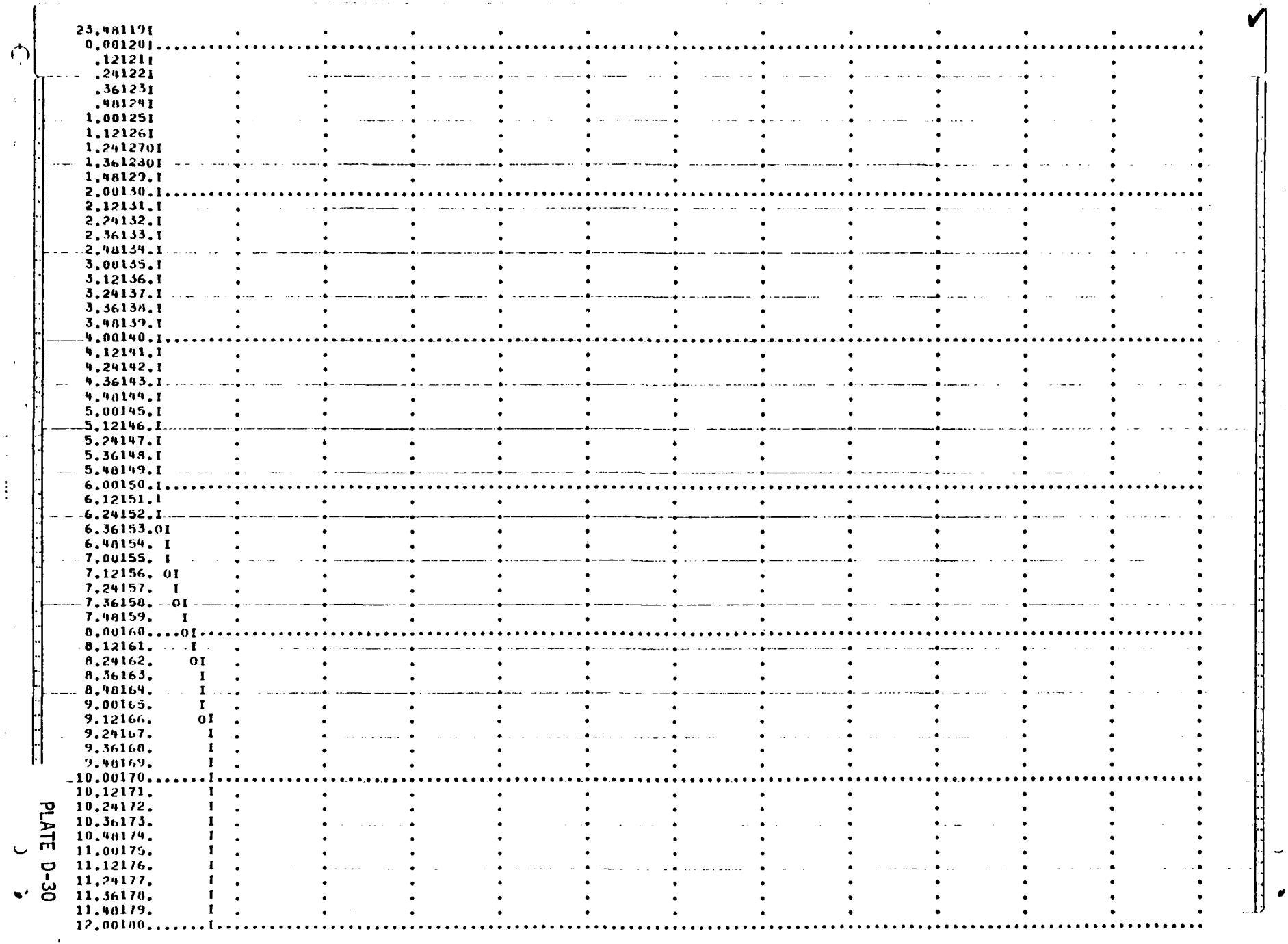
23.121161
23.241171
23.361181

PLATE D-29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1.36128OI
1.48129.I
2.00130.I
2.12131.I
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6.48154. I
7.00155. I
7.12156. OI
7.24157. I
7.36158. OI
7.48159. I
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8.24162. OI
8.36163. I
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9.00165. I
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9.24167. I
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10.12171. I
10.24172. I
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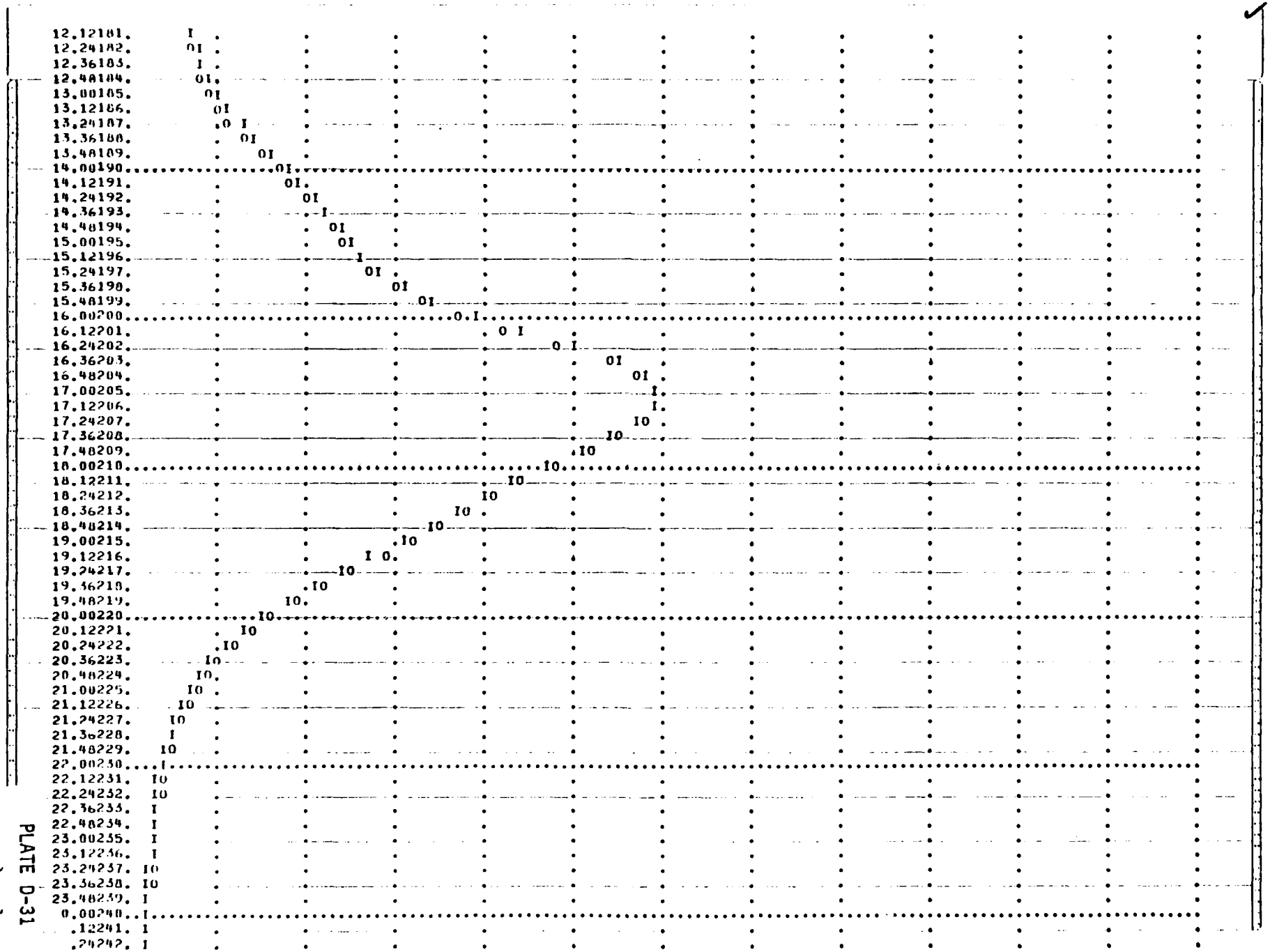
PLATE D-30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13.48189. OI
14.00190. OI
14.12191. OI
14.24192. OI
14.36193. I
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.12241. I
.24242. I

PLATE D-31

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5.12266.1
5.24267.1
5.36268.1
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8.36283.1
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9.24287.1
9.36288.1

PLATE D-32

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .10	RATIO 2 .11	RATIO 3 .12	RATIO 4 .13	RATIO 5 .14	RATIO 6 .15	RATIO 7 .50	RATIO 8 1.00
HYDROGRAPH AT	000001	2.89	1	1184.	1302.	1421.	1539.	1658.	1776.	5920.	11839.
		(7.49)		(33.53)(	36.88)(	40.23)(	43.58)(	46.94)(	50.29)(	167.63)(	335.25)(
ROUTED TO	000002	2.89	1	1165.	1283.	1401.	1518.	1637.	1755.	5896.	11793.
		(7.49)		(33.00)(	36.33)(	39.66)(	43.00)(	46.34)(	49.70)(	166.96)(	333.95)(

PLATE D-33

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	804.00	804.00	805.60
STORAGE	42.	42.	72.
OUTFLOW	0.	0.	1216.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	805.56	0.00	71.	1165.	0.00	41.20	0.00
.11	805.65	.05	73.	1283.	.80	41.20	0.00
.12	805.73	.13	75.	1401.	1.20	41.20	0.00
.13	805.82	.22	77.	1518.	1.60	41.20	0.00
.14	805.89	.29	79.	1637.	2.00	41.20	0.00
.15	805.97	.37	80.	1755.	2.20	41.20	0.00
.50	807.20	1.60	115.	5896.	7.00	41.20	0.00
1.00	808.19	2.59	148.	11793.	12.40	41.00	0.00


DATE
ILME